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The PROGRESSIVE FISH-CULTURIST

NOVEMBER 1941

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A SERIAL memorandum published occasionally for the advancement of fish-culture and fishery management in fresh waters.

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The PROGRESSIVE FISH-CULTURIST
News and Views from many Sources on Practical Hatchery Problems

Memorandum I-131 Washington, D. C. November 1941 No. 55

CARBARSONE TREATMENTS FOR OCTOMITUS

EXPERIMENTAL AND PRACTICAL TESTS SHOW VALUE OF NEW DRUG

By E. Clifford Nelson
Maine Department of Inland Fisheries and Game
Dry Mills, Maine

MAINE HATCHERIES HAVE ENCOUNTERED occasional difficulties traceable to the protozoan parasite, Octomitus salmonis. An unusually heavy mortality among brook trout fingerlings in the early months of 1940 apparently was caused by this organism. Serious losses began to occur soon after the fish were placed outdoors in gravel ponds in March. The writer had an opportunity to examine these fish in April. Of 20 fish examined, 19 were infested with Octomitus. No other disease or factor which could cause the mortality was found.

Calomel treatments carried out by the hatchery staff did not stop the mortality. Examinations made in the latter part of May showed a high percentage of infestations in the remaining fish. The present study was made in an effort to find a more effective treatment.

Carbarsone[1], a drug of proven value in the treatment of certain protozoan infestations in higher animals, seemed to be the most promising and plans were made to try it out. Carbarsone is supplied as a white crystalline powder which is practically insoluble in water but soluble in carbonate or bicarbonate solutions. During administration, the diet should have a high protein and vitamin (especially vitamin B content), but should be low in roughage and carbohydrate. These qualifications are well fulfilled by a liver diet.

The method used in mixing the drug with the liver was as follows: The carbarsone was dissolved in 1 percent bicarbonate of soda solution and was then added to finely ground sheep liver. The solution took the place of the water usually added to liver in breaking it up for feeding. The mixture was allowed to soak for from 4 to 12 hours to permit the liver to take up the drug. A good mixture which could be fed later without further breaking up was made by adding 1 part solution to 4 parts liver. To make a liter of "carbarsone-liver", for example, 2 grams of carbarsone were dissolved in 200 cc. of warm bicarbonate solution and added to 800 cc. of liver and stirred thoroughly.

1/ Eli Lilly and Company, producers of carbarsone, very kindly donated a supply of the drug for the initial experiments.

The initial experimental series was set up to determine as far as possible (1) the effective dosage, (2) the effect of the drug on the fish, (3) how long it takes for the drug to eliminate the parasite and (4) whether complete, permanent eradication can be achieved.

EXPERIMENTS SHOWED EFFECTIVENESS OF CARBARSONE

Experiments were begun on June 14. Fingerlings from a pond where serious mortality had been occurring were transferred to hatchery troughs. These fish had survived the most serious phase of the epidemic and the mortality had subsided to about 2 to 3 percent a week. The fish were about 6 months old and averaged about 4 cm. in length. Examination of 50 fish for Octomitus showed 43 (86 percent) to be infested.

Two hundred fish were placed in each of 6 troughs. Trough 1 served as a control and the others were given carbarsone-liver in concentrations ranging from 0.5 to 10 grams per liter. For each trough 200 cc. of carbarsone-liver was made up and allowed to stand for 4 hours. The control group was given liver to which bicarbonate solution but no carbarsone had been added. The 200 cc. of food was used up in 5 feedings, 4 given on June 14 and one on June 15. The fish had not been fed the day before, so the medicated food was accepted without hesitation. Plain liver was given afterward. Table 1 shows the infestation percentages before and at intervals after the beginning of the treatment. Ten fish from each trough were examined on the dates indicated.

Table 1. Percentage of infestations before and after treatment with varying dosages of carbarsone

Trough	Gms. carbarsone per liter food	Percentage of fish infested on dates indicated								Total loss
		6/14	6/15	6/16	6/17	6/18	6/19	6/22	6/25	
1	(control)	86	100	100	90	100	100	80	100	6
2	10.0	86	90	20	10	0	0	0	0	1
3	5.0	86	80	30	0	10	0	0	0	3
4	2.0	86	100	30	0	0	0	0	0	2
5	1.0	86	90	40	30	0	0	0	0	4
6	0.5	86	80	60	20	40	30	20	30	1

From the results obtained it appears that, with the methods used, carbarsone is completely effective in dosages of one gram or more per liter. A dose of 0.5 gram per liter was partially effective and with improved methods of feeding this concentration may be found completely effective.

During the experiment careful observations were made to detect any symptoms of toxic reaction to the drug, especially in the higher concentrations. Since no reaction occurred, it appears that brook trout fry tolerate the drug very well in concentrations well above the effective dose. It is not possible to say from this experiment whether these fish are more or less tolerant than higher animals.

It was observed in this experiment as well as in later ones that a noticeable drop in the infestation rate does not appear as a rule until about 48 hours after the beginning of the treatment. It is not possible to say how long the drug is retained.

PRACTICAL APPLICATION OF CARBARSONE

The results obtained in this initial experimental series seemed sufficiently promising to warrant large scale tests which in the last analysis would be the most significant in determining whether the drug is practical. Brief reviews of the applications made so far are given below.

(A) The first trial was made in a series of three ponds, Nos. 26, 27 and 28 (gravel-bottomed, plank-sided), containing a total of 25,000 brook trout fingerlings of about 4 cm. average length. Examination of 20 fish showed that all were infested with Octomitus.

A four-liter quantity of 2 grams-to-the-liter carbarsone-liver was made up, allowed to stand for 4 hours and fed in 3 feedings on July 6th and one on July 7th. Forty-eight hours later the infestation had dropped to 25 percent and at the end of 96 hours no infestations were found in 20 fish examined from each pond.

(B) The second test was made on a series of 25 ponds (gravel-bottomed, plank-sided) containing 100,000 brook trout fingerlings. These ponds were arranged in 4 lines of unequal length which converged to form a single line. Infestation percentages ranged from 70 to 100 with the lowest ponds showing the heaviest infestations. A total of 40 liters of 1 gram-per-liter carbarsone-liver was fed in 6 feedings on July 9th and 10th.

The effect was checked by examination of 25 fish from each of 4 pounds at intervals after treatment. These ponds were Nos. 8 and 2, head ponds in position, and Nos. 6 and 25, bottom ponds on 2 lines. Table 2 shows the results obtained.

Table 2. Percentage of infestations before and at intervals after treatments July 9 and 23.

Pond	Percentage of fish infested						
	7/9	7/11	7/12	7/13	7/23	7/27	8/16
8	70	52	20	0	0	0	0
2	70	--	10	0	0	0	0
6	100	61	36	10	35	5	20
25	70	64	44	25	50	16	35

In a system such as this one the lower ponds are apparently subject to reinfestation, possibly because of a heavy contamination of the ponds with the cysts of the organism. Eradication of the infestation from these lower ponds was not achieved and when it was found, on July 23, that the percentage of infested fish had risen, a second treatment was administered. Reduction of the infestation took place but a moderate return had been made again by August 16. A stronger dosage might have proven more effective; that given may be near the lowest effective dosage with this method of administration.

(C) A third treatment was carried out on 20,000 brook trout at another hatchery. A continuous though small mortality here seemed to be due to Octomitus. Each of 25 fish examined was found to be infested with this organism. These fish were

in troughs. A four-liter quantity of 2 grams-to-the liter carbarsone-liver was made up and let stand over night, then fed in 4 feedings during one day. Three days later no infestations were found in 25 fish examined. Eradication was apparently successful for no infestations were found in examinations made 15 and 25 days later.

(D) Several additional treatments were carried out as routine procedure. A shipment of 12,000 brook trout fingerlings, found to be infested with Octomitus when received, was isolated in hatchery troughs and treated before being placed in ponds. No evidence of the infestation was found at later examinations.

Another lot of 50,000 brook trout fingerlings was treated before transfer. A previous shipment from the same source had suffered heavy losses and an Octomitus infestation appeared to be responsible. Transfers after the treatment were made without loss.

Lake-trout fry apparently are also susceptible to infestations with Octomitus. A 40 percent infestation found in 5,000 fry was eliminated with 2 liters of 2 grams-to-the-liter carbarsone-liver.

DISCUSSION

During the progress of this study it appeared to the writer that the ability of Octomitus to cause illness and death in trout is largely dependent on the age of the fish. Fingerlings under 2 to 3 months of age seem to be fatally affected by Octomitus but those of about 4 to 6 months seem to withstand the infestation fairly well until shocked by transfer or other adverse conditions. Trout about 8 months old can be infested without suffering any apparently serious consequences.

There seems to be little doubt that treatment can be administered more effectively in troughs than in ponds. Complete and permanent eradication apparently is possible in troughs. On the other hand, fingerlings located in ponds with dirt or gravel bottoms may be freed of their parasites readily for a period, but apparently are subject to reinfestation, probably from cysts contaminating the pond.

From the results obtained under a variety of conditions, it appears that carbarsone is a very effective treatment for infestations of Octomitus. Although the drug costs about 10 cents a gram, the cost of treatment does not seem prohibitive. An average treatment requires about 1 gram (10 cents worth) per 3,000 fingerlings. At the present time we are attempting to devise a more effective method for retaining the drug in the food during administration to the fish.

EDITOR'S NOTE: In transmitting his manuscript for publication in the PROGRESSIVE FISH-CULTURIST, Dr. Nelson wrote the Editor as follows:

"A word of explanation in connection with the study may be of some interest to you. In the early spring when the Department of Inland Fisheries and Game gave me the opportunity to examine their ailing fish and I found Octomitus was present, I thought of the drug carbarsone with which I was familiar. The Eli Lilly Company very kindly supplied the drug in early May. I made plans to try the drug immediately after commencement released me from duties at the University of Maine where I was employed, fully expecting I was going to be the first to try it. Imagine my surprise when Eli Lilly informed me that my good friend Freddie Fish had just tried the drug and found it good. This was just a few days before I started my tests. I went ahead with my experiments as planned and toward the end of the summer got in touch with Freddie and found out what he was going to do with his

results. We seem to have followed a fairly similar approach, possibly because we received our training at almost the same time at the same place--Johns Hopkins School of Hygiene and Public Health. At any rate I was very pleased to have the privilege of supplying a confirmatory study for that made by Freddie."

STATE LEASES REELFOOT LAKE AS WILDLIFE REFUGE

With the recent leasing of a part of Reelfoot Lake as a national wildlife refuge for administration by the Fish and Wildlife Service, United States Department of the Interior, experts of the Federal conservation agency have begun the first of a series of cooperative projects designed to restore the habitat of what formerly was one of the greatest wildlife areas in the Southeast, according to a recent Service report.

Located in Lake and Obion Counties, in northwestern Tennessee, Reelfoot Lake is a favorite recreation area for hunters, fishermen, and other outdoor enthusiasts.

Recreation will not be affected, officials said. The refuge, a 9,000 acre area, includes primarily those parts of Reelfoot Lake that have been seriously affected by siltation and the infestation of pest plants.

The entire lake, however, will be considered in the rehabilitation program, according to J. C. Salyer, chief of the Division of Wildlife Refuges. Plans are now being made by State and Federal officials to hold the water at the level most satisfactory for the growth of desirable food plants. Other practices will be instituted to control pest plants, introduce wildlife food and cover plants, and provide additional recreational facilities.

A popular resting and feeding place for migratory waterfowl in the Mississippi Flyway, which flanks both sides of the Mississippi River, the Reelfoot Refuge is also an important nesting place for many kinds of aquatic birds, including egrets, herons, ducks, and rails.

"The cooperative agreement signed by the State and the Federal Governments will enable these agencies to join forces in restoring Reelfoot Lake as one of the most important fish and waterfowl habitats in that section of the country," Mr. Salyer said.

1940 MACKINAW PLANT AVAILABLE IN BEAR LAKE

First evidence that mackinaw trout are able to live for a considerable time in the waters of Bear Lake, Utah, is now reported from biologists of the Fish and Wildlife Service.

Gill nets set in the deep southern end of the lake are taking a number of the species, according to the report. The largest of these average about 14 inches in length.

Although mackinaws were first planted in Bear Lake as early as 1922, it is believed the catches now being made are from a plant of 20,000 fingerlings of 4 to 10 inches made in June of last year.

All reports indicate fishing for mackinaws in Fish Lake has been highly successful this season, despite a marked decline in catch in late July.

INCREASING THE CAPACITY OF A HATCHERY

CIRCULAR TANKS GIVE FOUR-FOLD INCREASE IN POTENTIAL CAPACITY [1]

By Gustave Prevost
Service des Pisciculturés
Saint Faustin, Québec

THE HATCHING AND REARING CAPACITY of a hatchery ordinarily is limited by the water supply and by the area of floor space in the building. The equipment of trout hatcheries usually consists of long, narrow, shallow troughs arranged in tandem. Such an arrangement permits the utilization of only about one-fortieth of the cubic capacity of a building for hatching or rearing purposes. A new type of equipment has been perfected which will increase the capacity of the hatchery four times.

The new equipment, developed at Saint Faustin, Québec, is illustrated in Figure 1. Small circular tanks are superimposed and suspended at one edge from a vertical pipe or column and are arranged on swivel fastenings so that each tank may be moved independently of the others. The vertical support is fastened both to the floor and to the ceiling so that the superposition of five tanks, with a 6-inch space between the top edge of one tank and the bottom of the tank immediately above, will make the total height of the working unit about 8 feet. A horizontal support constructed of pipe and fastened to the vertical column provides rigid support for each tank. The height of the water in the tank may be regulated as described below. The customary arrangement is to have the water enter the top tank and pass through each tank in the vertical series in order. An alternative arrangement is provided, however, whereby fresh water can be supplied directly to each tank. Although the general installation illustrated in Figures 1 and 2 has been in use during the 1938 and 1939 seasons for handling eggs, fry, and fingerlings, further experiments are in progress. Particulars of the new developments will be withheld until they have been tested thoroughly. The discussion in this paper, therefore, will be limited to the equipment in actual operation.

The method of regulating the level of water in the tanks is illustrated in Figure 2. One method (below) consists of a pipe placed inside the screen in the center of the tank which is connected beneath the tank to a horizontal pipe that leads to the inside edge of the tank immediately below. In the other, (upper tank illustrated) no pipe has been placed inside the screen but the water level is regulated by vertical and horizontal side pipes, arranged in the form of an inverted "U". Any desired level of water may be obtained by inclining the "U". The water is conducted to the tank below through the "U" which leads into a short pipe that carries the water to the inner edge of the tank. Note that a small hole is placed in the plug inserted in a "T" in the horizontal part of the inverted "U". If that hole were not present all of the water would be siphoned from the tank.

The lower portion of Figure 2 illustrates the manner in which the cradle or swivel supports for the individual tanks are constructed.

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[1] Reprinted by permission from Transactions of the American Fisheries Society, 70: 430-435; 1941.

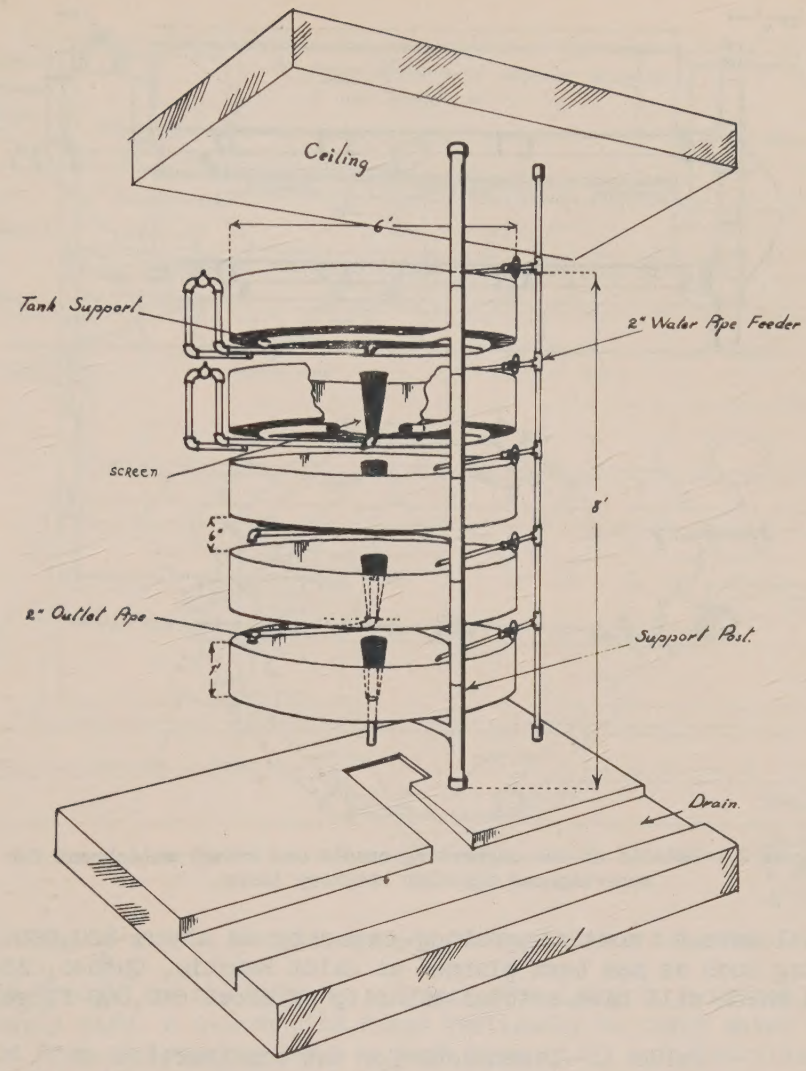

Figure 1.--Diagram of the vertical assembly of five superimposed tanks for the hatching and rearing of trout. Each tank rests independently on a support constructed of pipe (bottom of Figure 2) which is attached to the vertical supporting column so that tanks may be moved horizontally to facilitate caring for the eggs and young fish.

Principal dimensions for the construction of either 4-foot or 6-foot tanks are listed in Table 1. For experimental purposes the 4-foot tank is recommended.

The rather slender diameter indicated for the vertical supporting columns may surprise many fish culturists. However, it has been determined that a 2-inch pipe of the length required here will support a maximum weight of 2,000 pounds. The pipe for the supporting post should be chosen with care to insure that it is straight and has a smooth surface. Powdered graphite should be used inside the "T's" of the tank support to insure freedom of movement. To make the system rigid and keep it in proper alignment it is recommended that the various nipples and elbows used to construct the supports for the individual tanks be welded together.

To employ the system on a large scale, a general arrangement similar to that indicated in Figure 3 is recommended. A floor space 40 by 80 feet is required, in which eight groups of tanks, each group consisting of four series of five vertically arranged tanks may be accommodated. Thus, 160 tanks may be placed on one

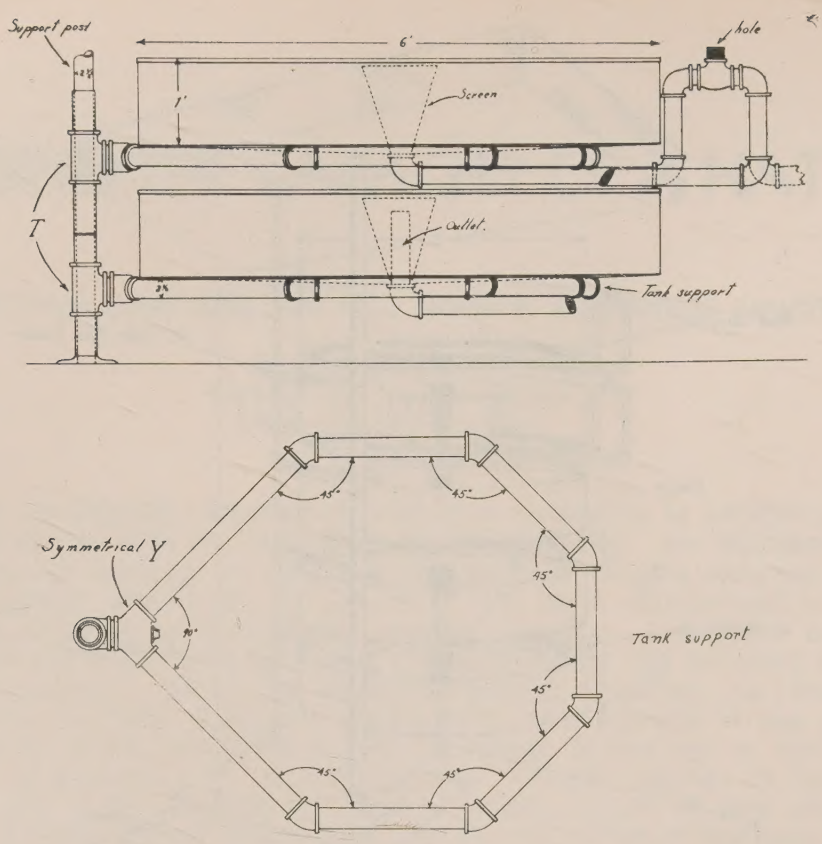

Figure 2.—Details of the supporting cradle and swivel attachment for superimposed circular hatchery tanks.

floor and will have a trout fingerling capacity of about 320,000. With a two-story building such as has been planned at Saint Faustin, Québec, 320 tanks can be accommodated which will have a total capacity of about 640,000 fingerlings.

Table 1.--Dimensions for the construction of 4-foot and 6-foot circular hatchery tanks

Item	Diameter of tank 1/	
	4 feet	6 feet
Approximate circumference of tank support..	11 ft.	16 ft.
Diameter of tank support.....	2 in.	2-1/2 in.
Diameter of "T's," "Y's," and short pipes around vertical support.....	3 in.	3-1/2 in.
Diameter of vertical support.....	2-1/2 "	3 in.
Slope of tank bottom.....	1/8 " per ft.	1/8 " per ft.
Gauge of galvanized sheet iron.....	20	10
Approximate weight of tank with water to 9-inch mark.....	600 lbs.	1,400 lbs.
Approximate capacity of trout fingerlings per tank.....	1,000	2,000

1/ Dimensions of pipe and pipe fittings are inside diameters

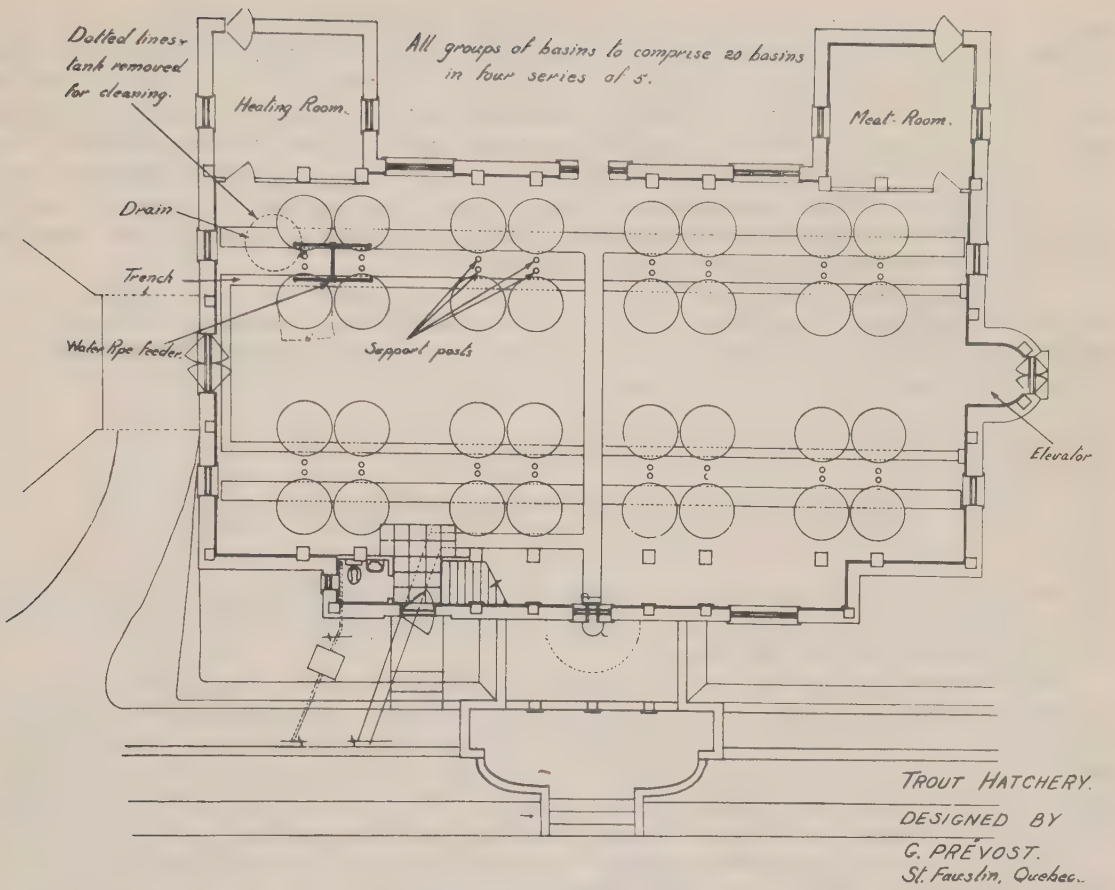

Figure 3.—Floor plan of a trout hatchery equipped with batteries of superimposed circular tanks.

Water is brought to the tanks by a 6-inch pipe lying in a trench in the floor. From this supply pipe, a 4-inch pipe rises vertically to carry water to each group of tanks, and from it branches lead to each tier or to each individual tank. (As indicated in Figure 1, fresh water may be furnished to each tank, or the water may flow downward from the top through each of the tanks in the vertical series, whichever is desired.)

When in position the tanks have little space between them, but because of the swivel arrangement each tank may be swung away from the others in the same vertical series. A tank moved out from the series may be cleaned rapidly, or the fish can be fed and any other necessary operations conducted with comparative ease. To drain an individual tank it is necessary only to remove the standpipe inside the center screen. If the side-pipe arrangement is used, the inverted "U" is shifted to a downward position and the water will pass out of the hole in the plug and fall into the drain (Figure 2).

The advantages of round pools over rectangular troughs have been described many times by different authors. Round pools are easy to clean, accommodate more fish for the same volume of water, are conducive to better and more uniform growth of the fish, provide good circulation of the water, and the fish are distributed more evenly throughout the tank. Uniform distribution is very important in caring for fry in tanks since they tend to crowd badly into the corners of rectangular troughs.

In addition to these well-known advantages, the circular tank system described here provides for optimum use of available space. The floor space necessary for the operation of 5 tanks is 50 square feet. Troughs to accommodate a comparable

number of fish, on one plan, would require 200 square feet. Because of the superimposed tanks the same water may pass through five tanks (under the two-floor plane at Saint Faustin, through 10 tanks). There is no objection to the use of the same water for 10 tanks of eggs and vesiculated fry, and according to the Taylor system, the same water may be used as many as 18 times during the feeding periods of fry and fingerlings without any adverse effects. If at any time the repeated use of the same water becomes a source of trouble, fresh water may be supplied to each individual tank by changing the drains so that they flow outside of the tanks and opening the individual feeder valves (Figure 1).

To compete with the capacity of the system proposed here an ordinary trough hatchery would require a floor space of 40 to 300 feet, instead of the 40 by 80 feet employed here. The advantages of the circular tank system are very material, therefore, from an administrative point of view.

TERRAPIN PRODUCTION AGAIN TOPPED AT BEAUFORT PONDS

All past records again were broken when 16,131 young diamond-back terrapin were produced this past season at the Beaufort (N.C.) fishery biological laboratory of the Fish and Wildlife Service.

This Federal farm, the world's largest for culture of the species, has hatched and reared over 160,000 of these salt marsh turtles for restocking Southern coastal areas since the artificial propagation of this species was first undertaken in 1909. The hatchery activities serve to provide an annual crop of young terrapin for restocking depleted coastal waters and also protect them during the first winter from destruction by serious natural enemies such as rats, mink, and gulls.

During the early summer the adult terrapin, consisting of 570 males and 2,025 females, deposit the eggs in special sand beds enclosed in 7 concrete pens arranged along the shores of the laboratory. A considerable increase in the production of eggs and young was obtained through recent improvements made in breeding pen arrangements as a result of experimental studies conducted under the direction of Dr. H. F. Prytherch and Captain Charles Hatsel.

By reducing crowding of the brood stock the production of young has been increased from an average of 1,680 per pen in 1937 to over 2,300 in 1940. In one special pen, allowing maximum space per adult, the output of young increased from 1,200 in 1937 to 2,480 in 1940.

The study of egg-laying by 320 newly confined, wild terrapin has also been continued and shows the following yearly increases: 1937 - 380; 1938 - 460; 1939 - 790; and 1940 - 1,174. This brood, in another year, should equal the output of other terrapin which have been in captivity for 15 to 30 years.

During the spring of 1941, a total of 15,035 young terrapin was released in protected wildlife refuges at Pea Island and Swanquarter, N.C., Cape Romain, S.C., and Blackbeard Island, Ga., and in cooperation with the Conservation and Fisheries Departments of the States of Virginia, North and South Carolina.

Apportionment of this year's output by States is as follows: Virginia - 2,500; North Carolina - 7,335; South Carolina - 3,000; and Georgia - 2,000. The greater allotment to the North Carolina Department of Conservation is made in return for previous contributions of adult terrapin for brood stock. Over 93 percent of these terrapin, which hatched in the fall of 1940, were successfully reared to an age of nearly 10 months before distribution in the South Atlantic region.

FOUNDERS OF FISH CULTURE

Livingston Stone

By Joel W. Hedgpeth
Sacramento, California

OF LIVINGSTON STONE, more than of any other one man, can it be said that he was the founder of the fish-cultural program of the Federal Government. He saw Federal fish-culture grow from two little cabins and a tent on the McCloud River in California to a far-flung enterprise with hatcheries in almost every state in the Union. When the site of Baird Hatchery, which he established in 1872, is completely submerged by the waters of Shasta Reservoir within a few years, the last trace of Livingston Stone's adventure in pioneering will be obliterated. Although he worked for the cause of fish-culture nearly 40 years and was responsible for the introduction of many fish which are now important elements of the fauna of California waters, he is in danger of being forgotten.

Livingston Stone was born on October 21, 1836, in Cambridge, Massachusetts, of parents descended from early New England families.1/ His father's people settled in Plymouth Colony in 1636 and his mother was a Winship. Although delicate in health, young Livingston was an excellent student and was graduated from Harvard with honors in 1857. He was a good amateur boxer and tennis player, but he was especially good at chess. In later life he once defeated 6 opponents in a simultaneous blindfold match. After completing his work at Harvard, Stone entered the Meadville Theological School (Unitarian), from which he was graduated in 1860, and for the next few years sought settlement as a minister. His poor health evidently prevented him from serving as a chaplain during the Civil War. In 1864 he was ordained pastor of the Charlestown, New Hampshire, church. He held this pastorate for 2 years, but since his health did not improve he decided to leave the ministry for some occupation which would allow him to be out of doors, although he was well liked by his congregation and was petitioned to remain.

How he came to choose fish-culture is not clear, but in 1866 Stone established the Cold Springs Trout Ponds at Charlestown, one of the first commercial trout hatcheries in the country. The enterprise was a success and he soon became prominent in what was then a new business. He established himself as one of the first authorities on trout culture and wrote one of its classic manuals, DOMESTICATED TROUT, which was first published in 1873. He also experimented with the artificial propagation of salmon, and started the first large-scale salmon hatchery in North America on the Miramichi River in New Brunswick. This was a cooperative venture of the New Hampshire and Massachusetts fish commissions, but for various reasons was abandoned after 2 years.

In 1870 a group of 5 men, William A. Clift, A. S. Collins, J. H. Slack, Fred Mather and Livingston Stone, met to organize a sort of trade association which they called The American Fish-Culturist's Association. This is now the American Fisheries Society. To Livingston Stone, who was the first secretary, must go no small share of the credit of guiding the society through its first years. A man of energy and enthusiasm, he wrote 500 letters during the first year of the young

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1/ The author is indebted to Mrs. Edmund Cushing Stone for much of the information contained in this paper.

society's life to get the organization on its feet for its first annual meeting on February 8, 1872. It was at this meeting that a broader policy than that of price fixing and exchanging trade secrets was adopted. As a direct result of the society's recommendations (it should not be forgotten that one of the members, Robert B. Roosevelt, was a congressman), an appropriation of $15,000 was made by Congress for the propagation of food fishes. At the meeting called by Commissioner Baird to determine the disposition of these funds, Stone recommended the transfer of the Pacific salmon to the Atlantic coast to replace the vanishing Atlantic salmon.

On July 6, 1872, Livingston Stone was appointed a deputy United States Fish Commissioner, with instructions to establish a salmon hatchery or egg-taking station in California or on the Columbia. When he arrived in California he found that no one seemed to know where the salmon spawned, and it was not until August 30 that he finally found the ancient Indian fishing ground on the McCloud River. On this site, 2 miles up the McCloud above its junction with the Pit River, he established his hatchery. It was a wild, picturesque place, a bend in the river with the dark trees growing to the edge of the river and a towering mass of gray limestone crags on the far side of the stream looming above the forest. In those days the railroad ended at Red Bluff, over 50 miles away, and there was no sawmill in the country. Stone and the two young assistants he had brought with him, Myron Green and Willard T. Perrin, set to work and in 15 days they had built a cabin and the essentials of a fish hatchery. It was too late, however, to gather many eggs, and during that first season, only 50,000 eggs were taken. Of these, 30,000 survived to the eyed stage and were sent east. A few hundred fingerlings were raised from this first shipment and planted in the Susquehanna River in March, 1873.

Of this first season and of many of the seasons to follow, Livingston Stone wrote long reports in which the details of life in a still wild and unsettled part of the world were recounted in such a vivid and entertaining manner that they still make interesting reading. In these long reports, published in the annual volumes of the Report of the United States Commissioner of Fisheries from 1872 to 1881, are stories of Indian scares, murders, and drunken carousals, of villainous characters lurking in the bushes and fights with one Leschinsky, who claimed the seining rights in the river (in these episodes it is evident that Stone's enthusiasm for boxing came in handy), and of the rampages of the McCloud River.

In 1875 Stone married the girl he had met when he was a preacher in Charlestown and brought her out to Baird for their honeymoon, although the country was far from civilized. Things came to such a pass by 1877 that the Army assigned a lieutenant and four privates to guard the hatchery. On December 9, 1875,the hatchery was set aside as a government reservation by Presidential proclamation, but it was not known as Baird until the establishment of a post office in 1878.

Livingston Stone had barely started his long career as the guiding spirit of Baird hatchery before he was called upon to introduce eastern fish to California waters. His first attempt was made with whitefish, early in 1873. A shipment of eggs was hatched in an improvised hatchery near Clear Lake, about a hundred miles north of San Francisco, and the fry planted in the lake. This attempt did not succeed, nor has any other experiment in transferring whitefish to California waters been successful. Stone had hardly enough time to get the whitefish eggs under way before he was called east to bring out a whole carload of fish. In a fruit car fitted out with tanks as an "aquarium car", Stone and his two assistants started west with over 300,000 assorted fish. They never reached California. The train was wrecked when the bridge over the Elkhorn River west of Omaha gave way, and the fish car was thrown into the river. Stone and his men managed to work free of the wreckage and swim to safety, but others were not so fortunate. A man was crushed in the cab and two drowned in the river.

Builders of the Baird hatchery: Myron Green, Livingston Stone, Willard T. Perrin. (Photograph taken in San Francisco, 1873.) Courtesy Mrs. Edmund Cushing Stone.

Nothing seemed to daunt those early fish-culturists, and their clothes were barely dry before they were returning east to try again with another load. This time it was a shipment of shad, which they succeeded in bringing to California with a loss of about 400 fish. This was the second planting of shad in California, the first having been accomplished by Seth Green in 1871. A year later, in 1874, Livingston Stone brought out another load of assorted fish, including black bass, catfish, pike, eels and lobsters, and in 1879 he brought out 150 striped bass, which he planted at Martinex. From the planting of the 135 survivors of the journey, and of some 300 fish in 1882, the striped bass became established within a few years and is now one of the major sport fishes of the San Francisco Bay region. The catfish and black bass also became well established in the state but none of the other fish "took".

Stone was superintendent of Baird continuously from 1872 to 1887, when he was made field superintendent for the Pacific coast. His first task in this new position was to secure the transfer of Clackamas hatchery, which he had established in 1877, from the State of Oregon to the Federal Government without cost save that of recent improvements. Before this promotion he was recommended to succeed Professor Baird as Commissioner of Fisheries after Baird's death in 1887 by his old friend Seth Green, but declined the honor because he believed that outdoor work was essential to his health. Activities at the Baird hatchery were suspended from 1883 to 1887, when construction of the railroad above Redding prevented salmon from reaching the hatchery. The work of gathering rainbow trout eggs at the station on Crooks Creek a few miles up the river from Baird, which had been established in 1879, continued during this interregnum. From this station came most of the rainbow trout eggs which were used in establishing the trout in streams of the eastern United States.

In 1892 Stone returned to his old post at Baird and remained there until 1897, when he was transferred, at his own request, to Cape Vincent hatchery in New York. It was with deep regret that Stone left California, for he knew he would never return, but his son Edmund was ready for high school and his wife longed for a less

lonely way of life. Although well past 60 when he left Baird, Stone could still play a good game of tennis and was famous for his skill at chess. As America's senior fish culturist he held a place of honor at the meetings of the American Fisheries Society and assisted in the dedication of the monument to Commissioner Baird at Woods Hole in 1903. He retired in 1906 at the age of 70 and spent his declining years with his family until his death on December 24, 1912. He is buried in the historic Mt. Auburn cemetery in Boston. His son is now living in Pittsburgh and Livingston Stone's first granddaughter is not yet 2 years old.

DEATH OF NOTED ICHTHYOLOGIST

Howard Walton Clark, noted ichthyologist and an employee of the former Bureau of Fisheries from 1904 to 1923, died in his seventy-first year in San Francisco, California, on August 10, 1941, after a brief illness. Before entering Government service, Mr. Clark had served for several years as assistant in the ichthyological and herpetological division of the Field Museum of Natural History at Chicago. He served as assistant in the old Division of Scientific Inquiry (now the Division of Fishery Biology) in Washington until 1910 when he became scientific assistant at the United States Fishery Biological Laboratory at Fairport, Iowa. Mr. Clark left the Government service in 1923 to become collector and aquarist at the California Academy of Sciences in San Francisco, and later became curator of fishes in that organization. Mr. Clark had a wide knowledge of natural history and was equally at home in botany and zoology. While employed by the Bureau of Fisheries he wrote many papers, principally in collaboration with the late Dr. Barton Warren Evermann. While stationed at Fairport, Iowa, he made extensive studies of the life history and conservation of the economically important fresh-water mussels, on which he wrote in collaboration with Dr. R. E. Coker and others. The most noteworthy of Mr. Clark's publications are: "Lake Maxinkuckee, a Physical and Biological Survey" (Department of Conservation of Indiana, 1920, 2 vols.) with Dr. Evermann as senior author, and "Check List of Fishes and Fish-like Vertebrates of North and Middle America North of the Northern Boundary of Columbia" (Report, U. S. Commissioner of Fisheries, 1928, Part 2, (1930) in collaboration with David Starr Jordan and Dr. Evermann. He also was editor of the ichthyological section of Biological Abstracts since the founding of that journal.

A SPORTSMAN-OPERATED REARING STATION

By Jerry Martin
Supervisor, Elkhart Conservation Club Station
Elkhart, Indiana

TROUT HAVE BEEN PLANTED in various waters of Indiana during a period of about twenty-five years. Little success had attended this program until the Fish and Wildlife Service and the Department of Conservation recently began a more careful selection of waters to be planted, and a more intensive stocking program. Particular success, as measured by the angler's catch, has attended the rearing of trout by sportsmen's organizations. A notable example is the activity of the Elkhart Conservation Club of Elkhart, Indiana, which operates a trout-rearing station in cooperation with the United States Fish and Wildlife Service and the Indiana Department of Conservation as part of a state-wide program.

Elkhart County, Indiana, is located in the northern tier of counties, and has more than 12 streams which are now supporting satisfactory trout populations. It is the center of trout-fishing enthusiasm in Indiana. The trout-rearing station, which was established during the spring and summer of 1934, is located at the junction of U.S. Highway 20 and Cobus Creek in the extreme northwest part of the county. The extreme distance from the station to any planting location is about 35 miles.

The water supply for this establishment is Cobus Creek, an unusually fine trout stream. At a point 60 feet above the fish-rearing pool a wood and concrete dam diverts the water into a sluice-box intake which discharges into a settling pond 15 by 20 feet in size. Two 4-inch pipes from this pond feed the rearing troughs and a 4 by 6-inch wooden sluiceway feeds a circular display pond. During the spring rains the streams become somewhat roily, but this condition passes very rapidly due to the volume of flow in the stream. In this section the stream has a

Settling pools (above) hold water diverted from Cobus Creek and supply the covered rearing troughs (below) and a circular display pond.

mean fall of 11 feet in one-half mile. The temperature during the month of July and August varies from a minimum of 56°F in the morning to a maximum of 69° during the late afternoon. The water system requires little maintenance except in the fall of the year when falling leaves have a tendency to clog the screens.

Two rectangular rearing troughs of equal dimensions (5 by 2 by 32 feet) with concrete sides and ends, and with gravel bottoms, are fed by the intake from the settling pond. As it enters into each intake the water is broken up by paddle wheels which prevent the migration of fingerlings upstream from the tanks. Water levels are regulated by flashboards in the lower end of each pool, in front of which is a hardware-cloth screen (8 by 8 mesh). The pools are entirely enclosed with poultry netting and in addition are provided with a roof or shade made of unbleached muslin painted with asphaltum.

The station is maintained by a very small fund as most of the labor needed for maintenance is donated. The supervisor is paid mileage for his daily trips to the station.

The trout reared at this station were obtained from Fish and Wildlife Service hatcheries as shown in Table 1. As is indicated by a comparison of weights with the number received, the trout from the Northville Station were small fish. Many of them were so small that they could not be handled satisfactorily in the rearing tanks.

Table 1 - Fish received by Elkhart Conservation Club during the spring of 1940

Date received	Species	Number	Total Weight	Received from
May 9	Rainbow trout	25,000	14.25	Northville, Mich.
May 9	Brook "	10,000	6.70	" "
May 9	Brown "	8,000	5.76	" "
May 10	" "	16,400	14.92	Manchester, Iowa
	Total	59,400	41.63	

Octomitus, which caused most of the trouble in past seasons, was kept in check in 1940. An inspection of the fry on the day of delivery showed evidence of the presence of this parasite, especially among the brook trout, which were in poor condition. The brown trout showed no evidence of the parasite.

The treatment to which the fish responded most readily was 1 gram of calomel to 4 pounds of food used in conjunction with cod liver oil as an internal lubricant. Control measures consisting of 2 salt baths per week reduced the infestation so that no additional loss was sustained. The salt bath was prepared by drawing the tank down to approximately 200 gallons, using 25 pounds of barrel salt to make the solution, and allowing the fish to remain in this for 10 minutes.

Beef heart was fed exclusively for the first 45 days. For the next 45 days beef liver was mixed with the beef heart in gradually increasing proportions until the entire feed was liver. Hewitt trout food was introduced at this point in the ratio of 20 percent by weight, and this diet was continued for the next 20 days. For the rest of the period a mixture of 60 percent beef liver and 40 percent Hewitt trout food by weight was fed. Salmon oil was used as a conditioner for the last 20 days that the fish were held in the tanks.

Table 2 - Kinds, amounts, and costs of fish foods fed trout in rearing troughs.

Food	Amount used	Cost	Total Cost
Beef Hearts	110 lb.	$11.00 per cwt.	$ 12.10
Beef Liver	806 "	14.00 " "	112.80
Hewitt Trout Food	180 "	10.00 " "	18.00
Salmon Oil	1 gal.	1.00 per gal.	1.00
Total	1,096 lb.		$143.90

Planting locations were selected early in the summer and the itinerary of the distribution truck prepared so that there was no delay in planting. The fish were distributed on October 20, 1940, and were carried in equipment belonging to the Indiana Division of Fish and Game. The fish were counted and the sample weights were taken as the truck was loaded. The planting crew was composed of members of

the Elkhart Conservation Club and the entire operation was supervised by the State Game Warden. There was no mortality in the handling of the fish from the station to the various streams stocked.

Table 3 Size, weight, and numbers of fish distributed 1/

Size	Number of trout planted			Total weight in pounds
	Brown	Rainbow	Total	
3-inch	1653	2022	3675	36.75
4-inch	2826	3454	6280	139.42
5-inch	2560	3130	5690	236.70
6-inch	530	638	1168	88.89
7-inch	373	457	830	118.52
	7942	9701	17643	620.28

1/ In addition to the above amounts 2200 brown trout, 2100 rainbow trout, and 6700 brook trout were released without recording size and weight. Also approximately 2000 of all 3 species escaped from the rearing tanks into open pools below the tanks from which they eventually escaped into Cobus Creek.

FISH COUNTING ON THE PLATTE RIVER

A two-year vigil at a spot on the Platte river that often will be bleak, cold and lonely has begun for Dexter B. Reynolds, Jr., of the conservation department's Institute for Fisheries Research, now tending the new fish-counting weir two miles upstream from where the river empties into Lake Michigan.

Reynolds will live in a cabin by the weir, fin-clip all fish migrating up and downstream, tag many of them and keep records that are expected not only to furnish answers to local fishing problems but to add considerably to what is known about rainbow trout as well.

The new weir, built under direction of Dr. David S. Shetter of the institute staff, is a stout structure set on a sheetpile foundation to prevent undercutting. Gates in the north wings permit passage of small boats. Inch and a half openings in the lattice allow smaller fish to swim through, but larger fish will be held in the traps for fin-clipping, jaw tagging, measuring, the taking of scale samples and other checks on their age and condition, over two full spring and fall runs.

None of the fish entering the weir will be removed from the stream. After measuring and marking, they will be sent on in the direction they were traveling when they entered the trap.

Located as it is between Big Platte and Round Lakes and Lake Michigan, the weir will show how much of the rainbow fishing in the Platte is provided by migrants from Lake Michigan and how much by rainbows resident in the lake and stream system. Local anglers also are interested in knowing what effect, if any, the sand bar at the mouth of the stream has on fish movements.

KEEPING BOOKS

ON A VERMONT TROUT STREAM

By Russell F. Lord
Fish and Wildlife Service
Pittsford, Vermont

THIS YEAR A NEW STREAM WAS ADDED to those that have been operated in Vermont for several years as test waters. This was a 20-mile stretch of the Battenkill River, long famous for its trout fishing. This stream's favorable water temperatures, uniform flow, quantity of fish food, and abundance of excellent pools, riffles, and shelter led Otis[1/] recently to describe it as nearly ideal for trout. The Battenkill is the longest and widest of the streams that have been designated as Vermont test waters. The test section begins at Manchester Depot, where the East and West Branches unite, and continues downstream approximately 20 miles to the New York State line. As on other test waters, anglers fishing this section of the Battenkill are required to secure a special permit, issued without charge, and to report their daily catches on forms provided for the purpose. On these forms the angler records the number of marked and unmarked trout of each species caught and kept, as well as the short fish returned to the water. Because of the willing co-operation of the local Fish and Game clubs,and the patroling done by the special test-water warden, a great number of fishing reports were received.

Vermont trout fishing in 1941 did not begin until May 7, one week later than usual, because a warm, dry spring had increased the fire hazard. However, May 7 found the familiar red boxes located at strategic points along the test section, fully equipped with report blanks and convenient pencils.

MAY STARTS OFF WITH LARGE CATCHES

It is always interesting to obtain the first fishing reports from a new study-area, especially in the case of a famous water like the Battenkill. On the opening day, 229 anglers reported a catch of 840 legal trout, some of which weighed several pounds. Sixty-five fish, or approximately 8 percent, were large brown and rainbow trout that had been marked by the removal of the right or left pelvic fin and planted in late fall and early winter by the Vermont State Trout Hatchery at Bennington.

The anglers kept very busy throughout the month, 1,681 fishermen reporting a May catch of 4,710 legal trout. The removal was at the rate of 1 trout for each hour and 18 minutes of fishing. The average catch per angler per day was about three fish (2.8),and the average fisherman-day consisted of 3 hours and 42 minutes.

1/ Otis, James C. 1941. A biological survey of the Battenkill River system in Bennington County, Vermont. Vermont Fish and Game Service Bulletin 27. January.

Brown trout, marked and unmarked combined, made up only 12.4 percent of the catch, thus sharing equal honors with the rainbows. This was a surprise to the writer, who has always thought of the Battenkill as a brown-trout stream. The catch of marked brook trout was the result of a planting made on May 26, during the current season. Of the 2,000 yearlings liberated, 518 were reported during the remaining days of the month, but it is safe to estimate that at least 1,000 were actually taken during the six days in question. This estimate is based upon past observations that anglers habitually overlook about 50 percent of their marked fish. Further evidence that the marked trout take was higher than reported is shown by the sudden jump in the daily catches of brook trout, which were entered upon the cards as being unmarked. During the 6 days preceding the introduction of the 2,000 fin-clipped fish, only 168 brook trout were reported. Then the catch for the next 6 days jumped to 964! It seems very reasonable to conclude that a high percentage of these fish had missing adipose fins overlooked by the anglers.

JUNE ANGLERS CAUGHT FEWER TROUT

June reports were watched with great interest to see if there would be any change in the angling situation, both in regard to the fishing load and the number of trout caught. The June summary revealed that a great reduction in the fishing effort had taken place. Less than half as many anglers were active, and the catch was somewhat less than a third of the May yield. In actual figures, 776 anglers reported a total of 1,444 trout. The rate of capture was 1 trout for every two hours of fishing. The average catch per angler per day was also reduced by about 30 percent, the computed figure being 1.9 instead of 2.8. The average fisherman-day consisted of 3 hours and 36 minutes, which was practically the same as in May.

It may be concluded that June anglers fished just about as long as in May, but the fish were somewhat harder to catch, perhaps because of a reduction in the number of legal trout available or because the unwary ones had already fallen victim to anglers' offerings, which amounts to about the same thing.

A little rainfall in June seemed to increase the percentage of brown trout, although browns, both marked and unmarked, made up only 18 percent of the total. Fifteen of the large, marked brown trout were caught,as well as 4 of the marked rainbow trout adults. Of the 103 marked brook trout reported during the month, only two were caught after the 18th of June. Evidently the anglers had quickly "cleaned up" on this lot.

FEWER REPORTS IN JULY

The July stream conditions were very much like those in June--warm weather and very low water. Anglers apparently did not find the stream much to their liking and consequently less than half as many reports were received as in June. A catch of 442 trout was reported by 307 fishermen. These fish were caught at the rate of 1 trout for 2 hours and 6 minutes of fishing, which practically duplicates the June record. The average catch per angler per day was also about the same, being 1.5 instead of 1.9. The average length of the fisherman day was slightly reduced, being computed at 3 hours even. In other words, there was no real change in the quality of the angling when compared with June, but the average angler did not fish quite so long.

The yield of brown trout, all of which were unmarked, was again 18 percent of the monthly total. Only two brook trout of the May 26 stocking were reported during July, thus supporting the earlier idea that most of them were caught soon after liberation.

SEASON ENDS IN MID-AUGUST

The water continued low and clear up to the close of the season on August 14 and these last two weeks saw a further reduction in the fishing load. Only 59 anglers reported a total of 115 trout. The removal was at the rate of 1 trout for each hour and a half of fishing. The average catch per angler per day was again 1.9, as in June. The length of the average fisherman-day was practically the same as in July, being 2.9 or three hours. Although there was some indication that trout "came a little better" in the final days of the season, as far as effort and yield were concerned, there was little change in the quality of the Battenkill angling from June first to the end of fishing.

Unmarked brown trout made up 9.6 percent of the August catch, and two more of the May 26 plant of brook trout were reported.

RESULTS OF THE SEASON AS A WHOLE

The first test-water study on the Battenkill resulted in obtaining angling reports from 2,823 fishermen, who caught 6,711 trout. The fish were caught at the rate of 1 trout per 1.5 hours of angling. The average catch per angler per day was 2.4, while the average fisherman-day consisted of 3 hours and 36 minutes.

The fishing pattern was entirely normal. Most of the angling took place in the early part of the season, with 59.5 percent of the anglers reporting during the month of May, and their catch representing 70.2 percent of the season's total. In June, 27.5 percent of the fishing effort took 21.5 percent of the total yield. Combining May and June, we find that more than 90 percent of the Battenkill trout were secured before the first of July.

It is,of course,impossible to tell from one year's observations whether the 1941 production was typical. The low percentage of brown trout was particularly surprising. The total figures,by species,show that brown trout made up 14 percent, rainbows 14 percent, and brook trout 72 percent of the catch. This includes all the fin-clipped fish, which made up 11.9 percent of the preceding totals.

The unmarked brook trout were very conspicuous in the 1941 harvest. It is possible, however, that many of these were stocked fish, planted just before or during the early season by local fish and game clubs. In order to determine the definite results of stocking,all future Battenkill plantings should be fin-clipped.

WHY HAVE TEST-WATER STUDIES?

The writer has sometimes been asked how, in the words of the interested party, "this sort of investigation would do the fishing any good?"

In the first place, test-waters are the result of the realization that it is impossible to improve an angling situation without first learning more about this same situation. The test-water investigation is merely one method of obtaining facts instead of opinions. Ten different fishermen might have ten different opinions as to the quality of the angling or the effect of stocking. The test-water method of securing reports from all those fishing in a designated area makes it possible to obtain a great amount of unbiased information. For example, good, fair, and poor anglers fishing under good, fair, and poor conditions,all report their results. This can be expressed in various ways, such as "average catch per angler per day," "average catch per fisherman-hour," and so on, but the result is a figure which represents what the average angler secures under average conditions--a fairly good yardstick for measuring the quality of angling.

Table 1. Catch Record on Battenkill River, 1941
(Season May 7 to August 14 inclusive)

Item	May	June	July	August	Total
Monthly catch					
Rainbow trout	519	212	105	16	852
Brook "	3,015	865	253	86	4,219
Brown "	506	245	82	11	844
Marked fish[1]					
Rainbow trout	74	4	--	--	78
Brook "	518	103	2	2	625
Brown "	78	15	--	--	93
Total	4,710	1,444	442	115	6,711
Number of hours fished	6,256.00	2,824.75	911.75	170.25	10,162.75
Percentage of season's catch	70.20	21.50	6.60	1.70	100.00
Number of anglers	1,681.00	776.00	307.00	59.00	2,823.00
Av. number of trout per angler	2.80	1.90	1.40	1.90	2.40
Av. number of trout per hour	0.75	0.51	0.48	0.68	0.66
Hours required to catch 1 trout	1.30	2.00	2.10	1.50	1.50
Percentage of unmarked trout:					
Rainbow trout	11.00	15.0	24.0	13.9	12.7
Brook "	64.00	60.0	58.0	76.5	62.9
Brown "	10.70	17.0	18.0	9.6	12.6
Percentage of marked trout:					
Rainbow trout	1.60	--	--	--	1.2
Brook "	11.00	7.0	--	--	9.3
Brown "	1.70	1.0	--	--	1.4
Total	100.00	100.0	100.0	100.0	100.1

[1]The rainbow and brown trout were large adults planted in the late fall or early winter prior to the open season. The brook trout were liberated on May 26, 1941.

Today, on the Battenkill or elsewhere, no one knows the best or most efficient way to bring about the best possible fishing, for the simple reason that machinery has been lacking to measure the results of any policy of fishery management. Management in trout fisheries has consisted almost entirely of restricting the catch by regulations and attempting to build up the trout supply by artificial stocking. Now, for the first time, a yardstick is available for measuring the Battenkill angling. One season will not tell the story. Information of the kind being obtained in the Vermont test-water studies is beginning to come in from widely separated sections of the country. Eventually it will be possible to classify fishing waters as good, fair or poor and to base this classification upon actual production figures. It will be possible to compare the results of different management policies and to follow the plan that seems to fit the particular situation.

Hugh McCormick Smith

DR. HUGH McCORMICK SMITH, former United States Commissioner of Fisheries, died suddenly at his nome in Washington, D.C., on September 28, 1941, at the age of almost 76 years.

Dr. Smith's life was a busy and a full one. He was educated in Washington, D. C., where he graduated from Central High School, and later from the Medical School of Georgetown University. Although he never practiced medicine, his interest and training in that field are often reflected in his publications. Indeed, he wrote a few short papers on medical subjects. While in high school he had acquired an interest in birds and his earliest scientific papers dealt with ornithology. Although he never lost interest in birds, he was destined to become famous in the science of the fisheries. This was determined when he entered the service of the United States Fish Commission in 1886, under the First Commissioner Prof. Spencer F. Baird.

After serving in various subordinate grades in the United States Fish Commission (changed to the United States Bureau of Fisheries in 1903) Dr. Smith was appointed Assistant in charge of Statistics and methods of the Fisheries, a major division of the Commission in 1893. In 1897 he became Assistant in charge of Scientific Inquiry. During 1901 and 1902 he served as Director of the United States Fisheries Biological Station at Woods Hole, Massachusetts, and in 1903 he was appointed to the newly created position of United States Deputy Commissioner of Fisheries.

In recognition of Dr. Smith's outstanding ability and achievements, a committee of famous naturalists representing the American Association for the Advancement of Science recommended his appointment to the highest office in the Bureau of Fisheries to the then President elect, Woodrow Wilson. This appointment came in 1913, soon after the new president was inaugurated. Dr. Smith had the unique distinction of being the first Commissioner who advanced through the ranks of the service from the bottom to the top, and he is the only Commissioner who served under all his predecessors in that office. He was Commissioner until 1922, therefore serving during the troubled period of the World War, and the lean years that followed. Dr. Smith's administration is noted for the efficient organization that was perfected, for the widespread improvements in the fisheries, and for the fair and harmonious cooperation with other fisheries organizations of the states.

Many honors, some of them involving great responsibility, came to Dr. Smith during his service with the Bureau of Fisheries. In 1900 he was appointed representative of the United States at the first international fishery congress in Paris; in 1905 he again represented this country at the third international fishery congress in Vienna; and in 1908 he served as secretary-general of the fourth international fishery congress held in Washington, D. C. In 1910 Dr. Smith served as expert special assistant at the arbitration of the North Atlantic fisheries dispute, held at the Hague. The same year he was named by President Taft a member of the international commission for the adjudication of disputes arising with Canada and Newfoundland under the award of the Hague tribunal. In 1912 he represented this country on the Permanent Council for the Exploration of the Sea, and a year later President Taft appointed him joint commissioner on behalf of the United States for the control of the fisheries in the boundary waters of this country and Canada.

A less energetic man, burdened as Dr. Smith was with administrative duties during most of his 36 years of service with the Bureau of Fisheries, would not have found time to conduct many investigations and to write numerous scientific articles and books. However, Dr. Smith somehow found time to travel extensively, often carrying his investigations to remote and almost inaccessible places, not only in this country but also in our insular possessions and in foreign lands. During his connection with the Bureau of Fisheries he published at least 80 papers, either alone or with co-authors, in the Bureau's series of publications, and during the same period about a hundred other papers appeared elsewhere.

Dr. Smith was not ready to retire after severing connections with the Bureau of Fisheries. After a short visit to Brazil he was called to Siam (in 1923) as adviser to the king in matters concerning the fisheries, and three years later he was appointed director of the Siamese Department of Fisheries. He served in that capacity until 1934, accumulating vast information on the local fishes, and also a large collection. Each year during his service in Siam he published one or more papers on the fishes of that country. He succeeded in instituting modern methods of fishing, as well as proper rules and regulations for the conservation of the fisheries of Siam.

During the last several years of his life, though his health was failing, Dr. Smith was busily engaged as associate in zoology in the Smithsonian Institution, studying the specimens of Siamese fishes he had brought to this country, assembling his field data, and writing a comprehensive monograph on the fresh water fishes of Siam. It is understood that when he laid down his pen for the last time, on September 22, 1941, this large piece of work was nearly finished.

Dr. Smith was a fluent writer. All his works are characterized by an excellent literary style, and by the clear and readily understandable presentation of facts. They deal with a wide range of subjects, though mostly with aquatic animals. Some of his papers are strictly technical; others are popular or semipopular. He named and described quite a number of new species of fishes, and a large number of fishes and other animals were named for him.

Dr. Smith was a gentleman of culture and refinement. Those who worked with him on field trips found him a sympathetic and delightful companion. He had a way of making himself agreeable wherever he went, and his charm seemed to increase with age. It may be truthfully said of him that he grew old gracefully.

Samuel F. Hildebrand.

Native Indian fisherman starting out in his reed boat (balsa). If he is lucky his catch may consist of half a bushel of fingerling-sized fish,all less than six inches in length.

FISH CULTURE

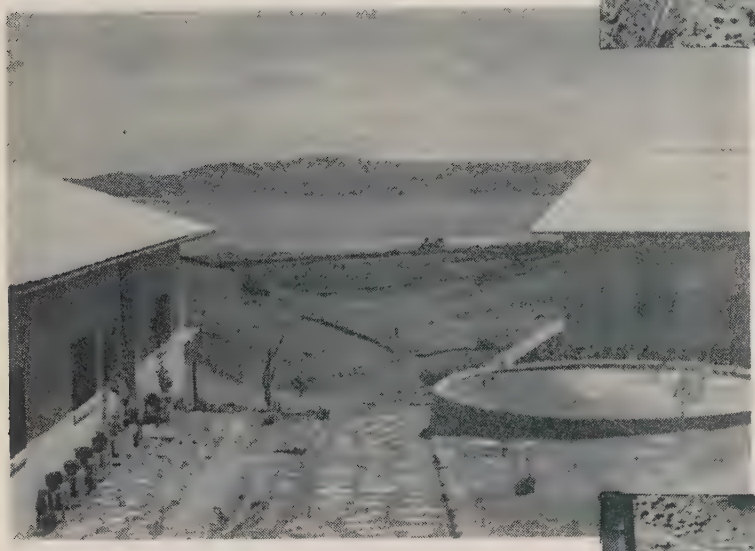
ON LAKE TITICACA

By M. C. James
Division of Fish Culture
Washington, D. C.

PERU AND BOLIVIA share between them the thousands of square miles of Lake Titicaca's area. They also share the scanty yield of "bogas" (oversize killifish) and "suchis"(catfish) which the Lake produces. In the high Andes (12,500 feet,plus) food production is all-important, and the two Governments sought, by enlisting the aid of fish-culturists, to harvest more and better fish from their liquid asset. Although near the equator, Lake Titicaca is in general of the deep, cold alpine type, with a number of shallow, warm, marshy bays. Guide books insist upon saying that it has brackish water. The water is actually hard, somewhat alkaline, but not brackish. The Lake drains through one outlet into another lake in Bolivia which has no outlet, and is consequently saline. Lake Titicaca is fed by several rivers

Lake Titicaca fishermen returning to their home port, shown in far background. Their fishing craft cost nothing but labor.

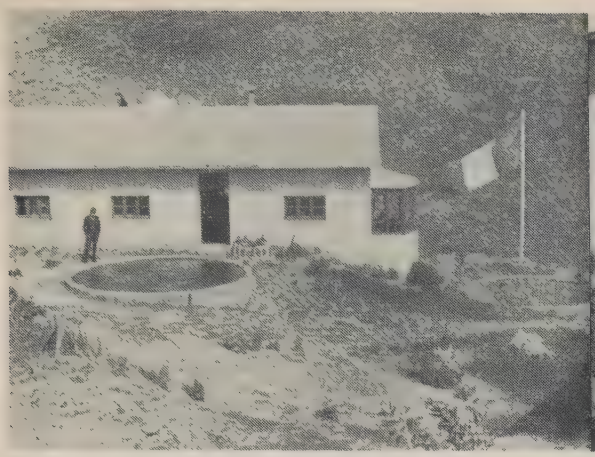
Panoramic view of Peruvian-Bolivian fish hatchery development (criadero) at Chucuito, Peru. The spring water hatchery supply appears in the foreground.

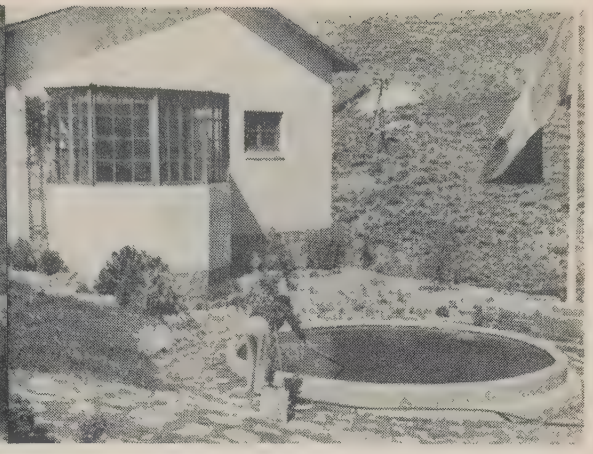


Lake Titicaca from the hatchery area.

A full year's subscription to the PROGRESSIVE FISH-CULTURIST will be awarded to the first fish-culturist who can identify this mysterious device.

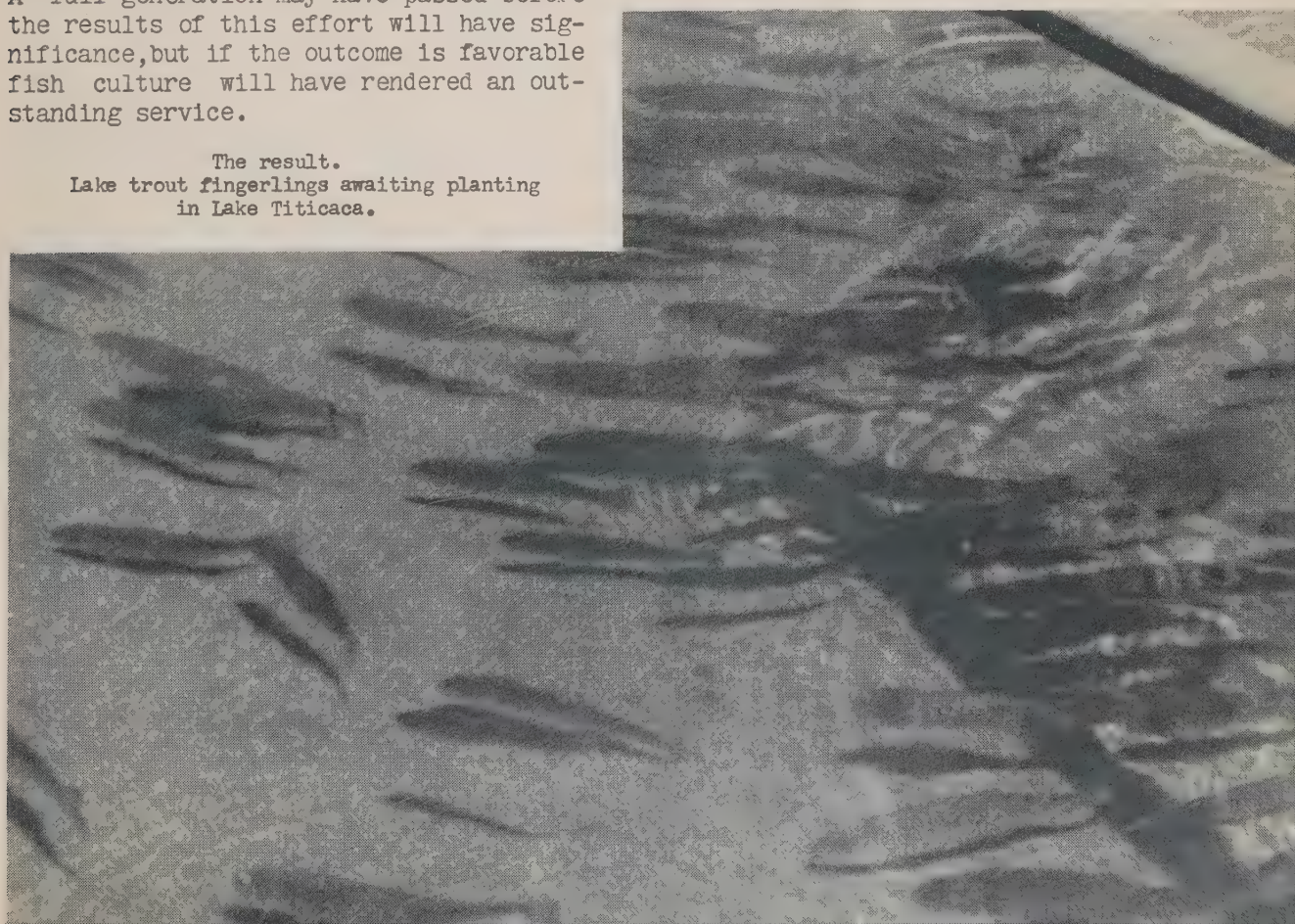
supplied by perpetual snows of the Andes, and in the vicinity are several smaller lakes suitable for (and now being stocked with) rainbow trout. The former U. S. Bureau of Fisheries offered aid, loaning the author to make a preliminary survey and plan a program during the winter of 1935-36. Acting upon his report, they later employed J. Adger Smythe as "Technico Piscicultura," meaning fish-cultural technician. The results, as of the winter of 1940-41, are shown in the accompanying photographs.





(Left) The Peruvian headquarters at the Chucuito hatchery. Each government assigns representatives to look after its interests. Note lawn-mowing equipment in right foreground.
(Right) There's one of those things again. The man is (A) admiring his reflection? (B) trying to recover his watch? (C) Doing the same thing that hundreds of North American fish-culturists do every day? Answer Yes or No. It is doubtful if any of the pioneer fish hatcheries in the United States could boast as solid, permanent construction as this initial effort in Peru.

The first shipment of eggs, furnished through the courtesy of the Michigan Conservation Department, was made during the winter of 1938-39 and consisted of 250,000 lake trout eggs. The following year approximately a duplicate shipment was sent from the Cape Vincent, New York hatchery of the Fish and Wildlife Service. Two million whitefish eggs followed, supplied from Put-in-Bay, Ohio, through the cooperation of the state and federal governments. To date, all efforts to hatch whitefish at Lake Titicaca have been unsuccessful. However, further shipments of both whitefish and lake trout are planned, and possibly lake herring may be tried. A full generation may have passed before the results of this effort will have significance, but if the outcome is favorable fish culture will have rendered an outstanding service.



The result.
Lake trout fingerlings awaiting planting in Lake Titicaca.

THE POTATO RICER IN THE FISH HATCHERY

HOW TO TRANSFORM A KITCHEN GADGET INTO A FISH FEEDER

By C. R. Mitchell
Fish and Wildlife Service
Cortland, New York

ANY OF THE FOLLOWING STATEMENTS are offered in the spirit of suggestion, and entirely without ulterior designs of "talking" anyone into using the much cussed and discussed potato ricer as an implement for feeding fish. We like the ricer as a means to an end. We also, and for the same reason, like the spoon, feather, screen-bottom dipper, and (confidentially) we will admit using a feed scoop when feeding blower-mixed feeds to large fingerlings. The feed scoop and ricer don't work so well for fry just beginning to feed, and by the same token a spoon is not so hot as an implement with which to feed large fingerlings. We change the feed as the fish advance in size, and by force of circumstances we change the method of getting the feed to them. Hence we find the potato ricer on our implement rack.

At the earliest possible time--when the fish get past the "soup" stage and become large enough to hit and break up solid particles of feed of appreciable size--we prefer to feed mixtures that contain the least possible amount of added water. The amount of water added to the feed (to facilitate mixing) is decreased gradually, as the fish increase in size, until none at all is being added. We also begin feeding dry meal and meat mixtures as soon as possible. Some mechanical device, such as the ricer, is needed to get such feeds to the fish in particles of proper size and without excessive pollution.

We have been using the ricer for three successive seasons. During this time we have tried some three or four different types and discovered slight, but important, differences. The "5 & 10" variety lacks the strength to stand up under constant hard use. Bent handles or off-set cup will interfere with the action of the plunger and spoil the efficiency of the entire outfit. After trying the several ricers we have finally adopted the "Universal," the strongest type that has come to our attention. (Incidentally, we have two of the "Universal" ricers that we have used for two seasons to handle the heavy 50 percent dry-meal mixture, and they are still in good condition.)

The Universal comes equipped with a cup that is perforated both on the sides and bottom. In feeding fingerlings from 2½ inches up, the side perforations do not detract greatly from the efficiency of the ricer. In feeding smaller fingerlings, however, especially while these are being held in troughs, the perforations allow entirely too much feed to be expressed at one time. This difficulty is overcome by using a modified cup, the side perforations of which are sealed over with solder. A convenient way of sealing the openings is to plug the inside of the cup tightly with a tin can (No. 5) wrapped with sheet asbestos, and then to apply the solder from the outside. The outer surface can easily be smoothed with the hot soldering copper, while any excess solder that works through to the inside can be removed with a broken-off section of a half-round file.

The next important modification of the ricer is a rubber gasket attached to the plunger. This functions in about the same manner as the piston rings in a gas motor, except that instead of preventing the escape of gas and oil it keeps the feed from rolling back around the edge of the plunger when force is applied to the handles. This "back-firing" of feed is probably one of the most discouraging features of the ricer "as bought", and without the retaining gasket one will spend almost as much time removing feed from the upper part of the plunger as he does in actual feeding, especially if a viscous mixture is being used.

For the gasket we favor a section cut from the leg of a discarded rubber boot. This is attached directly to the plunger and held in place by a disc of 28-gauge metal. One method of holding the basket and disc in place is to drill through the disc and plunger and fasten with stove bolts. Flat-head bolts are necessary, the heads being flushed with the disc by counter sinking.

A much neater and more satisfactory method is to "spot weld" the disc to the plunger. It is only necessary to drill the disc for this type of fastening and to cut corresponding holes in the gasket. No holes are required in the plunger. We prefer one-quarter-inch holes for spot welding. After getting the disc and gasket ready they are clamped in place to the plunger with G clamps. With a very hot soldering copper "spin" a small amount of solder into the hole by holding the copper point in the perforation. The hole is completely filled by holding the heel of the copper directly on it and applying the solder stick to the point of the copper, from which it will flow back to the heel and smoothly seal the weld. For replacing worn gaskets the disc can be removed by melting out the spots with a hot copper and re-soldering after the new gasket has been inserted.

It is advisable to cut the gasket with a diameter about half an inch greater than that of the plunger. The excess can be trimmed off a little at a time until the gasket will just fit tightly into the cup. If a moderate amount of care is exercised in fitting the gasket,the bugaboo of feed "rolling" back past the plunger will be entirely eliminated.

The perforations in the stock ricer-cups are three thirty-seconds of an inch in diameter. This size is too great for feeding fingerlings less than 1½ to 2 inches long, as the "worms" of feed expelled from the ricer will immediately swell to about half again the size of the perforation. By placing an order with the makers of the "Universal" we managed to get several blank cups. We marked these out for drilling with a scriber and made up one set drilled with a No. 55 wire twist drill and another, for early use, with a No. 60 drill.

By exercising a moderate amount of care we had good luck in accustoming fingerlings to a comparatively "dry" mixture of feed after an initial period of about 10 days on "soup". We found it advisable to follow the ricer feeding with a small amount of "soup" spread just above the tail screen of the trough for the benefit of those fish too small to attack the larger particles. As stated above a little water is first mixed with the meat so that it will break up more readily. Without any added water the meat has a tendency to float and it is not advisable to allow too much to remain on the surface until the small fingerlings have learned to come up for the feed. However, as the fish become stronger they will attack and break up long strings or "worms" of feed and take a large amount of it from the surface. As they approach this point one can safely withhold more and more water from the feed and within a short time eliminate the addition of water entirely.

This year we started 1¼-inch fingerlings on a mixture of hog spleen and beef liver, in equal proportions, to which was added 25 percent (by weight) of No. 6 dry mixture (composed of equal parts of cottonseed meal, whitefish meal, wheat flour middlings, powdered dry skim milk and 4 percent salt.)

Regardless of the kind of feed used or the size of fish fed, one must learn to apply just the right amount of pressure on the ricer handles to expel the feed only as fast as it can be spread evenly over the surface of the water. Too much pressure will cause large "globs" of feed to come off the cup and as the worms have a tendency to adhere together the real function of the ricer is defeated thereby. The purpose of using the ricer is to distribute particles or strings of feed of such size that the fish can break them up quickly and with little effort. When using dry mixtures, the quicker the fish get the feed the less loss of the dry components is likely to occur.

When in operation the ricer should be moved in a rotary direction, with the bottom of the cup held about one inch (never full depth) under the surface of the water. Contrary to the general opinion, large lots of fish can be fed much more quickly with a ricer than with a spoon.

Regardless of the type of feed being used and the size of perforations in the ricer cup, one will, at certain times, find it difficult to expel particles of feed that are of satisfactory size. Often this condition can be overcome by holding one hand under the ricer cup and rubbing the feed off the bottom of the cup by a rotary motion of both the ricer and the hand, the feed being spread by the same motion.

As bought, the joint connecting the ricer handles is fairly loose, or will soon become so. By "peaning" down this rivet until the action is quite stiff one will get better results in use, especially with the softer-type feeds.

Probably those who have the spare time and curiosity to endure this far are saying, "Why all this fuss to transform a double-jointed kitchen gadget into a fish feeder? Why not swap the thing back to the cook for a hamburger?" We hasten to repeat that we have no love for the ricer in itself. However, we do have a lot of confidence in certain types of feeds, and the ricer--so far--seems to be the best implement for getting these feeds to the fish in the best way. If someone comes along with an apparatus that bids fair to outmode the ricer for this purpose we will gladly give it a try-out. If it is better than the ricer maybe the cook can have his ricer back for almost any kind of handout.

LIGHTNING AFFLICTS FISH WITH "LINGERING DEATH"

When indirectly struck by lightning, fish apparently may be "killed" but not actually die for some days.

This odd phenomenon is described in a report from the Cortland (N.Y.) hatchery of the Fish and Wildlife Service, United States Department of the Interior:

"On June 22, 1941, lightning struck a large hemlock tree about 150 feet from the rearing ponds of the Cortland hatchery.

"A number of adult brook and brown trout were seen to be in a partially stunned condition immediately after the bolt struck. Several of the fish seemed to recover in a short time. Those seeming to show lasting effects had difficulty in maintaining their equilibrium and moved about with head pointed downward, tail partly out of water. Bodies were contorted similar to modified letter 's.'

"During early July considerable mortality suddenly occurred among the adult fish and examination revealed brain hemorrhages, gill hemorrhages, and distended auricle."

A SPAWNING KNIFE FOR TAKING SALMON EGGS

By Edgar Ledgerwood
Bonneville, Oregon

THE SPAWNING KNIFE PRESENTED HERE had its inception at the Oregon Fish Commission's egg-taking station on the North Santiam River. It has been used successfully there for the past 17 years in taking the eggs from Chinook salmon (Oncorhynchus tschawytscha) and at other Oregon hatcheries in taking both chinook and silver salmon (O. kisutch) eggs.

The instrument shown in the accompanying sketch is easily constructed. It is made from a worn butcher knife with a 6-inch blade of soft, tough steel. A dull knob is added by soldering two pieces of metal (the approximate size shown in the sketch) together over the end of the blade (fig. 1), one on each side, at an angle of 40 degrees with the cutting edge. The knob formed does not cut, but acts only to hold the edge of the blade in the fish and should be smooth and rounded with no sharp edge or projection which could cut or prick an egg. (The knife can be made in many different ways, but this particular type is used as an example because it is easily constructed. The length of blade, length and size of the added knob, and the angle of the "V" can be varied without impairing the efficiency of the instrument, but in all cases the angle should be a clear cut "V").

SKETCH OF SPAWNING KNIFE MADE FROM OLD BUTCHER KNIFE

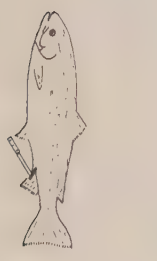


FIG. 2

FIG. 3

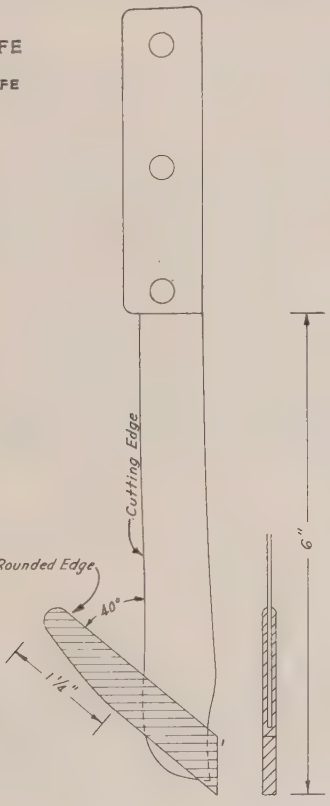


FIG. 1

To spawn with this knife, insert the knob in the fish's vent, (fig. 3), and, holding the blade at a slight angle with the fish's belly, cut upwards from the vent to the head. The knife cuts with an incising action and the blade at no time comes in contact with the eggs. Only the knob enters the fish's belly, so be sure that it has no rough edge which might damage the eggs.

It has been found best to insert the knob before the fish is lifted from the spawning platform and to lift the fish to a vertical position over the spawning receptacle with the aid of the knife, using it as a hook (fig. 2). This serves the double purpose of preventing the spilling of eggs from the vent and having the knife in readiness to cut as soon as the fish reaches the proper position.

Several scales will usually be found in the "V" after cutting each fish. These should be removed before cutting again. This can be done easily and without loss

of time with the thumb and forefinger of the left hand while reaching with the knife for the next fish. Practice will of course be necessary before the desired efficiency can be reached.

Correct care of the knife is necessary to insure proper workability. A keen edge should be kept on the blade at all times by use of a file. To sharpen, stroke the blade in a line parallel to the knob. A knife of soft, tough steel has been found preferable to one of hard steel because it can be sharpened more quickly.

This spawning knife has the following important features: (1) the spawn can be taken free from cut eggs; this fact allows the eggs to be cleaned up more quickly and easily with less early handling, and in all probability adds to the percentage of eggs fertilized; (2) no eggs are lost from the vent when the fish is lifted from the platform; (3) it is comparatively safe because the cutting hand is not near the blade, which in itself is partially protected by the knob; (4) it allows fast and efficient work by aiding the spawner in lifting the fish.

PERUVIAN GOVERNMENT INTERESTED IN JEFFERSON STREAM STOCKING UNIT

Acting Forest Supervisor A. R. Cochran has received a request from the Washington office of the U. S. Fish and Wildlife Service for blue prints of the recently constructed stream-stocking unit, which is in use on the Jefferson National Forest. This unit, built from Forest Service plans and specifications in a Roanoke body shop, was described at length in a special article written for THE PROGRESSIVE FISH-CULTURIST several months ago by Wildlife Technician T. C. Fearnow. Through THE PROGRESSIVE FISH-CULTURIST officials of the Peruvian Government learned of the new type of fish-distribution equipment and submitted a request for plans to the American Government through the Fish and Wildlife Service.

Because of the fact that racks and other special features of the body were constructed by Forest Service workmen after the body was accepted from the builder, a new, all-inclusive plan is being developed to show the construction details of the complete stocking unit. Assistant Forest Engineer S. N. Goller is preparing the new plan. -- Reprinted from THE WILDERNESS TRAIL, August, 1941.

BLACK BASS IN LAKE MEAD

According to observations made by Drs. H. S. Davis and Paul R. Needham, of the Fish and Wildlife Service, conditions in Lake Mead this summer were very favorable for the spawning of black bass, with the water level much higher than during previous summers. Thousands of young largemouth bass, principally of this year's hatch, were seen along the shoreline. While the bass in the lake were already showing signs of a food deficiency, rainbow trout taken in the river below were found to be exceedingly fat and in good flesh, and to have fed on algae, mayfly nymphs, midge larvae, and other insects.

NOTES AND NEWS

Storage of Glycogen in Fish Muscle

FISH SPECIES MAY DIFFER GREATLY in their ability to utilize carbohydrates, and in nature poor carbohydrate assimilation may go hand in hand with a carnivorous diet, according to a preliminary study by Harold Heifetz of the University of Illinois. Mr. Heifetz recently submitted the following account of his experiments to the PROGRESSIVE FISH-CULTURIST.

"Twelve fish representing eight species were examined for muscle glycogen. They were taken from two large lakes in the same watershed in central Illinois--Lake Decatur near Decatur and Lake Chautauqua near Havana. The fish were kept in large aquaria at 77° for several weeks with the exception of the eel and the bowfin (dogfish) which were held about one week. All were fed moderate amounts of live earthworms of the genus, Helodrilus, obtained from the local sewage-disposal plant.

"A glycogen determination of these worms, using 200 grams wet weight, yielded 4.29 grams or 2.14 percent. This is several times the amount found in fish muscle.

"The method of extraction was as follows: the fish were killed with liquid air or dry ice to keep excessive muscular activity at a minimum. They were scaled, skinned, gutted and the muscle removed from the entire body, with the exception of the head. The tissue was ground in a mortar with fine sand, and the mixture placed in a beaker and heated for 3 hours with an excess 60 percent potassium hydroxide on a steam bath. The solution was filtered and the residue discarded.

"The glycogen was precipitated from the filtrate by the addition of two volumes of 95 percent alcohol and allowed to stand for 2 days. The precipitate was separated from the liquid by centrifuging instead of by decantation. The precipitated glycogen was then washed with 66 percent alcohol until nearly white, each washing being followed by centrifuging. It was then moved from the centrifuge tube to a watch glass and the alcohol allowed to evaporate off. After 2 days of evaporation the material was dried to constant weight.

"The data on the yields of muscle glycogen are shown in Table 1., where the different species are arranged in order of increasing percentages. It may be noted that this order corresponds to a change in the general character of the natural diet. The largemouth bass, bowfin and eel are usually regarded as strictly carnivorous, the two species of crappies occasionally take vegetable matter, while the yellow bullhead, carp and redmouth buffalo habitually utilize as much as 50 percent of plant material in their diet when it is available. The glycogen yield of the latter three is 15 to 20 times that of the carnivorous kinds. It is interesting that these differences should be found among specimens kept under identical conditions and fed a high glycogen diet. Although the number of determinations is small it suggests that there is a difference in the ability of different fish to utilize carbohydrates."

Table 1. Muscle Glycogen Content of Illinois Fish

Name	Number of fish	Weight of Muscle in grams	Glycogen yield in grams	Percentage of Glycogen yield
Largemouth bass *Huro salmoides*	1	103.20	0.1898	0.0018
Bowfin *Amia calva*	1	279.85	0.5212	0.0019
Eel *Anguilla bostoniensis*	1	529.62	1.0365	0.0020
Black crappie *Pomoxis nigro-maculatus*	3	83.50	0.0718	0.0086
White crappie *Pomoxis annularis*	3	127.00	0.1254	0.0099
Yellow bullhead *Ameiurus natalis*	1	91.53	0.2378	0.0260
Carp *Cyprinus carpio*	1	155.00	0.4998	0.0322
Redmouth buffalo *Megastomatobus cyprinella*	1	180.00	0.6370	0.0354

(Mr. Heifetz acknowledges his indebtedness to Dr. F. R. Steggerda of the Department of Physiology of the University of Illinois and the people of the Illinois Natural History Survey who furnished the fish and cared for them during the course of these experiments.)

Sharp Freezing Fails to Kill Bacterium salmonicida

SHARP-FREEZING FOR 24 hours followed by cold storage is not the answer to the problem of how to kill *Bacterium salmonicida*, the cause of furunculosis, which might be present in fish or fish viscera to be used for feeding fingerling fish, according to recent experiments by Dr. Frederic F. Fish of the Fish and Wildlife Service's Seattle and Leavenworth Laboratories. Dr. Fish placed cultures of *B. salmonicida* in the sharp freezer at Leavenworth for 24 hours and then transferred them to the cold-storage room. On September 19 he found that series sharp-frozen on May 21 and others on August 1 were still viable. Dr. Fish plans to conduct further studies to learn whether prolonged sharp-freezing may prove a practical method of killing these bacteria.

Tagged Bass Yield Interesting Results

TAGGING OF 92 largemouth black bass in Lake Murray, South Carolina, yielded a return of nearly 20 percent, with all but one of the returned tags carried over winter and some retained as long as 4½ years, according to information supplied by West Jacocks, Deputy Game Management Agent of the Fish and Wildlife Service.

The bass, obtained from rearing pools near Columbia, were tagged and planted in the fall of 1934 by Mr. Jacocks and Doctors Havilah Babcock and J. E. Copenhaver of the University of South Carolina, with the cooperation of the State Game Department. Red celluloid belly tags, 1½ inches long by 1/4 inch wide, were supplied by R. A. Nesbit of the former Bureau of Fisheries. Thirty-six of the bass were tagged and released on October 31st and the remaining 56 on November 2, 1934. The size of the bass at the time of planting ranged from 6 to 10½ inches.

The fish were tagged and released immediately into the waters of Lake Murray without a holding period to determine mortality following tagging. One tag was found in the mud in the vicinity of the tagging station, and one tagged bass was seized by a duck as it was released. In all, 18 bass have been recaptured. The first recovery was made 17 days after the tagging, about 7 miles from the place of release. Thirteen were recaptured the following spring, two in 1937, and two in 1939. A detailed record of these recaptures is given in the following table.

Black Bass Tagging Operations, Lake Murray, South Carolina

Tag No.	Date Planted	Size Planted (in inches)	Date Retaken	Size When Retaken	Place Retaken	Approximate Miles From Planting
	1934					
115245	11-2	10	11-19-34	10	Metz Creek	7
115252	"	9	3-3-35	9-3/4	Ballentine	0
115261	"	10-1/2	2-28-35	10-1/2	"	0
115209	10-31	8-1/2	3-2-35	9	"	0
115289	11-2	7-1/2	3-4-35	8-1/4	"	0
115256	"	8	3-16-35	8-1/2	"	0
115283	"	8-1/2	3-18-35	8-1/2	Metz Landing	1
115213	"	9-1/2	3-16-35	10	Ballentine	0
115254	"	9	"	9-1/2	"	0
115205	10-31	8-1/2	3-15-35	9	"	0
115278	11-2	9	4-20-35	10	John's Creek	7
115202	10-31	8	5-26-35	9	Ballentine	0
115263	11-2	10-1/2	5-25-35	13-1/2	8 miles above dam	4
115280	"	7	11-15-35	--	Tag found in mud at Ballentine	0
115262	"	9	3-8-37	13-1/2	Rocky Creek	17
115287	"	8-1/2	4-6-37	14	Metze Place	15
115264	"	8-1/2	3-21-39	16-1/2	3 miles above dam	7
115267	"	9	3-25-39	1 pound; 12 ounces	Derricks Place	6

Bass and Sunfish in South Africa

THE CAPE PISCATORIAL SOCIETY of Cape Town, South Africa, has for several years carried out a program of importing bass and bluegill sunfish from America. From time to time the PROGRESSIVE FISH-CULTURIST has published reports on the success of these importations, which were concluded with a shipment of spotted bass received by the Society on October 22, 1939. The 10th annual report of the Society contains this account of the introduced fish.

"Spotted Bass. As in the cases of the smallmouth bass and the bluegills, the spotted bass grew fast in our mild climate, and they spawned at the Jonkershoek Hatchery before we had had them for a year. They made their nests in very shallow water around the margins of their pond and did not require gravel or stones on which to deposit their eggs. The breeding season was short, from the last week of September (in a mild Spring) to about the middle of October; and considering that there were only a few pairs of breeders our first crop of fingerlings was very satisfactory. The growth of the spotted bass fry was just as rapid as the fry of the other two species, and fingerlings of from 3 to 5 inches long were available for distribution by the end of 1940. Fifty were placed in the experimental section of the Berg River at Groot Drakenstein in December 1940. As the spotted bass were imported mainly for use in the brown acid-water rivers, 50 were released in the Nieuwejaars River near Elim in December 1940. On January 22, 1941, 100 were released in the Palmiet River at the Elgin road bridge; and these were seen to begin to hunt the shoals of small Galaxias minnows which abound in the shallows. On the same day, another 100 were placed in a farm dam of about 4 acres, which is fed partly by water from the Palmiet River siphon and contains no competitive fish. The prospects for bass fishing in the Palmiet River may be improved for the future by reason of the recent completion of a private irrigation barrage across the river some miles below Elgin, which is intended to impound the water for a mile or more upstream. A small batch of spotted bass fingerlings was put into a pool of the Bot River, just above the old Caledon road bridge, on March 30, 1941.

"Smallmouth Bass. The success of the smallmouth bass released in the experimental section of the Berg River at Groot Drakenstein is very encouraging, and it alone completely repays the protracted work which was involved in importing this game species. In the last Annual Report it was recorded that as a result of the first stocking in December 1938, two of the smallmouth were caught on March 3, 1940, which measured 11 and 12 inches long. There had been no indications, however, that the stocked fish had bred in the river in the Spring of 1939. The Berg River ran very high during September, October and November, 1940, and it was not possible to see anything denoting spawning. But on February 23, 1941, a very warm day when the river had become low and very clear, it was found that an amazing change had come over the fish population of this part of the river; and that, without a shadow of doubt, the smallmouth bass had bred very successfully during September or October 1940, in spite of the full state of the river. The banner-tail fingerlings of the smallmouth bass had suddenly become the most prominent fish in the shallows of the pools. They ranged from as small as 2-1/2 to 6 inches long.

"Bluegill Sunfish. Within the short period of two and a half years since the imported stock first bred at the Jonkershoek Hatchery and at Howick Hatchery, Natal, bluegills have been widely distributed over Southern Africa; and such is their precocity and prolificness that there must now be hundreds of thousands of them spread amongst many waters."

ABSTRACTS

Through the courtesy of the Secretary and the Chairman of the Committee on Publications of the American Fisheries Society, the following abstracts of papers presented at the 1941 meetings of the Society have been made available for publication in the PROGRESSIVE FISH-CULTURIST.

OBSERVATIONS ON THE WINTER FEEDING HABITS OF EASTERN BROOK TROUT IN RELATION TO NATURAL FOOD ORGANISMS PRESENT

By Justin W. Leonard
Michigan Department of Conservation, Lewiston, Michigan
Contribution from the Michigan Institute of Fisheries Research.

AT THE HUNT CREEK EXPERIMENT STATION near Lewiston, Michigan, water was first admitted to a newly-excavated stream channel on October 16, 1940, after adult aquatic insects had apparently disappeared. The first bottom organisms to invade the new habitat, blackfly larvae, were observed one week later. It is concluded that these and subsequent invaders were drift-borne from natural areas upstream. On December 20, a square-foot bottom sample contained 187 organisms representing 8 species, with a volume of 0.20 cubic centimeters. On February 4, 1941, a sample contained 21 species, and 1,535 organisms, with a volume of 1.575 cubic centimeters.

The section was first screened and drained down on January 18, 1941. At that time, 34 eastern brook trout were removed, of which 22 were retained for stomach analysis. These averaged 80.3 millimeters in total length and 5.0 grams in weight. A comparison of stomach contents with bottom samples revealed that feeding and natural occurrence of food organisms were not in the same ratio. For example, volumetrically, larvae only 56.9 percent of the bottom fauna; mayfly nymphs formed only 7.5 percent of the diet but 24.8 percent of the bottom fauna. The average number of food organisms per stomach was 252, the average volume of contents of an individual stomach 0.425 cubic centimeters. The average square foot of bottom contained 1,114 organisms with a volume of 1.275 cubic centimeters.

BOTTOM ORGANISMS IN FERTILIZED AND UNFERTILIZED FISH PONDS IN ALABAMA

By Henry H. Howell
Fish and Wildlife Service
Bowie, Maryland

THIS STUDY WAS CONDUCTED on two experimental farm fish ponds located on the Agricultural Experiment Station at Auburn, Alabama. Bottom samples were taken from June to November 1940 in a 1.5 acre fertilized pond and in a 1.8 acre unfertilized pond. Two methods of sampling were used, the Petersen dredge method and the stove-

pipe method. The latter method consistently gave a better quantitative sample than the former. The fertilized pond produced 382.9 pounds of fish per acre; the unfertilized pond produced 147.1 pounds per acre. The area of the fertilized pond was reduced 2/3 of its original size during the fall drouth, causing a tremendous concentration of bottom organisms. The 5-month average weight of bottom organisms in the fertilized pond was 68.27 milligrams of dry organic matter per square foot, and for the unfertilized pond the average was 19.62 milligrams. The plankton samples for the same period showed in the fertilized pond an average weight of 5.81 milligrams per liter; and in the unfertilized pond an average of 2.54 milligrams per liter. Routine stomach analyses of bream from both ponds showed that the fish in the fertilized pond had plenty of insects throughout the period, and that in the unfertilized pond they had sufficient insects in June only. The fertilizer more than doubled the weight of fish, plankton and bottom organisms in the fertilized pond as compared with those in the unfertilized pond.

POPULATION STUDIES OF FIVE FLORIDA LAKES

By O. Lloyd Meehean
U. S. Department of the Interior
Fish and Wildlife Service
Welaka, Florida

POPULATION STUDIES WERE MADE of five representative Florida lakes in the Ocala National Forest, which ranged from immature to very mature in ecological age and development. The largemouth black bass made up a constant proportion of the total weight of the fish population. There was a direct relation between the number of pounds of fish per acre and the degree of ecological maturity of the lake. The number of largemouth black bass was from 12 to 27 per acre, which is less than one-third of the number stocked 3 years previously.

The make-up of the supporting populations of other species of fish was variable from lake to lake, indicating that there may be considerable variation in species associations. The total number of legal fish per acre also varied from lake to lake but tended to be greater in the more mature lakes. The total weight of supporting populations was also related to the maturity of the lake. The ratio of supporting populations also was directly related to maturity of the lake. The ratio of supporting populations to predators was constant. Thirty-one percent of the legal largemouth black bass taken weighed 3 pounds or more.

Yearling largemouth black bass were taken in two lakes and yearling suckers only in one. No immature gar fish were taken, a possible indication that inadequately stocked lakes are susceptible to biological control of predatory fishes, except under certain circumstances.

A METHOD OF MEASURING THE NUMBER OF ECTOPARASITES INFESTING HATCHERY FISH WITH PARTICULAR APPLICATION TO GYRODACTYLUS

By Daniel R. Embody
Laboratory of Limnology and Fisheries, Cornell University
Ithaca, New York

A QUANTITATIVE METHOD IS PRESENTED for estimating the intensity of infestation of the ectoparasite Gyrodactylus on goldfish. When infested fish are immersed in solutions of Cresol the Gyrodactylus leave the fish and drift about in the liquid. The number of organisms in the solution may then be counted by standard methods. A series of experiments was performed to determine the variability in counts of parasites as it might be influenced by the use of several different fish, by different workers making the counts, by the time interval between the immersion and counting, and by the concentration of the cresol. From the experimental evidence obtained, it was concluded that considerable variability was associated with the counts made on different fish. Counts made by different workers and counts made after various immersion times did not vary significantly. Concentrations of 1:4000 to 1:666 (parts cresol: parts water) appeared to be satisfactory for use with Gyrodactylus. The method described is suitable for use with modern experimental designs and provides a quantitative "yardstick" for judging the effectiveness of various treatments for controlling ectoparasites on fish.

FISH POPULATIONS IN THE BACKWATERS OF WHEELER RESERVOIR AND SUGGESTIONS FOR THEIR MANAGEMENT

By Clarence M. Tarzwell
Tennessee Valley Authority
Decatur, Alabama

DURING THE PAST THREE YEARS several methods have been used in an attempt to determine the fish population of the lower TVA Reservoirs. With the exception of poisoning selected areas to obtain the total population, all methods have been proven more or less selective for certain species. A barrier seine made of cotton sheeting was used to shut off the area to be treated so the fish could not escape during treatment and the rotenone would not spread to other areas.

Population studies were made in this manner on two small areas in 1940, and in 1941 on three larger areas of 4.4, 7.9 and 6.5 acres. In the area most typical of the backwaters of Wheeler Reservoir the standing population was 291 pounds per acre. The percentages of the total number and weight of fish present represented by each of the main groups of fish were as follows: game fish 30 and 3.9 percent, pan fish 28 and 6.7 percent, food fish 1 and 4.1 percent and coarse fish 41 and 85.2 percent respectively.

One of the areas studied which has a narrow connection with the reservoir has been screened so the fish cannot reenter. It is planned to stock this area with bass, bluegill and gambusia so that almost the total fish population will be of value for angling. By thus excluding the coarse fish it is hoped to greatly increase the number and yield per acre of desirable fish and to improve fishing. If this experiment proves successful there are several other areas in Wheeler Reservoir which could be so managed.

GROWTH OF THE ROCK BASS AMBLOPLITES RUPESTRIS (RAFINESQUE), IN FIVE LAKES OF NORTHEASTERN WISCONSIN

By Ralph Hile,
U. S. Fish and Wildlife Service,
Ann Arbor, Michigan

THE FORMS OF THE GROWTH CURVES OF ROCK BASS from four lakes with medium-hard to hard water bore a general resemblance to each other, but differed sharply from the curve for rock bass from a lake with extremely soft water. With the exception of a slight increase in growth in the third year of life the annual increments of length of the rock bass of Nebish Lake (4.0 p. p. m. of bound CO^2) tended to decrease consistently beyond the first year. The good first-year growth in length of rock bass of Allequash, Silver, and Trout Lakes (16.8, 15.0, and 18.7 p. p. m., respectively, of bound CO^2) was followed by poor growth in the second, third, and fourth years of life. This poor growth was followed in turn by good growth in the fifth and sixth years. The annual increments of length tended to decline beyond the sixth year of life. The growth of rock bass of Muskellunge Lake (10.0 p. p. m. of bound CO^2) declined sharply in the second year of life. The annual increments of length were fairly constant in the second to seventh years (inclusive) but declined beyond the seventh year. In each lake the males grew more rapidly than the females.

The time of attainment of the legal total length of 7 inches in the different lakes ranged from late in the sixth growing season in Nebish and Trout Lakes to the middle of the eighth growing season in Muskellunge Lake.

Rock bass of corresponding length from Allequash, Silver, and Trout Lakes were so nearly of the same weight that one curve described the length-weight relationship of the three stocks. Muskellunge Lake rock bass were considerably lighter than fish of the same length from these three lakes, and Nebish Lake rock bass were somewhat lighter than those from Muskellunge Lake.

FISH MANAGEMENT PROBLEMS OF HIGH WESTERN LAKES WITH RETURNS FROM MARKED TROUT PLANTED IN UPPER ANGORA LAKE, CALIFORNIA

By P. R. Needham, Aquatic Biologist
U. S. Fish and Wildlife Service
Stanford University, California
and
F. H. Sumner, Assistant Biologist
Oregon Game Commission
Portland, Oregon

UPPER ANGORA LAKE in the high Sierras was selected for an experimental study run from 1934 to 1936, inclusive. It is a five acre lake at 7,800 feet elevation seven miles south of Lake Tahoe. General ecological conditions and management problems of such high lakes are discussed. Low water temperatures over most of the year limit both growth and production of aquatic foods. The standing crop of bottom foods averaged 49 pounds (wet weight) per acre. Dominant aquatic foods were midge larvae, bristle worms (Oligochaetes) and scuds (Hyalella). Stomach examinations of trout indicated dominant food eaten were midge larvae and pupae. Aquatic foods formed over 66 percent by number of foods eaten.

Two lots of marked eastern brook trout were planted; one of 5,028 averaging about two inches in length, and another of 2,080 averaging five and a half inches in length. The small fish were planted in September, 1933 and the larger in June of 1935. Both lots were marked by removal of fins. The lake outlet was screened to prevent them from leaving the lake.

A creel census was taken over the angling seasons of 1934, 1935 and 1936. Only weight, species, date of capture, and the presence or absence of marks was recorded. No record was kept of the length of time each angler fished or of anglers who failed to catch fish.

Catches of both marked and unmarked fish totaled 89 trout in 1934, 809 in 1935, and 211 in 1936. Eastern brook trout were dominant in the catches. A few rainbow and brown trout were taken each year.

Over the three-year period covered, only 4.3 percent of the 5,080 two-inch eastern brook trout and 25.6 percent of the five-and a half-inch fish, were reported caught. From the results of work presented in this paper and the results of the work of other investigators cited, losses of trout planted are extremely heavy regardless of the size of fish planted.

Better survival of small two-inch trout was obtained after three winters in the lake than for five-and a half-inch fish after only one winter in the lake. Marked fish of both plants formed 77 percent and 58 percent respectively, of fish creeled in 1935 and 1936. No marked fish were reported caught in 1934. The plant of small eastern brook trout made in the fall of 1933 contributed most fish to anglers the second year after planting. The plant of larger trout contributed most in the same season in which they were planted. The small marked trout grew at a rate of over 2.5 inches per year for the three-year period covered by the creel census. The larger grew at a rate of 1.7 inches per year.

Production in pounds per acre was 15.8 in 1934, 21.2 in 1935, and 17.0 in 1936. Eastern brook trout formed 28 percent by weight of all trout landed in 1934, 56 percent in 1935, and 48 percent in 1936.

Age determinations from scale studies indicated that the majority of eastern brook trout caught were in their third year and the presence of incoming young in their first and second years gave evidence of successful natural propagation in the lake. No rainbow trout less than three years or brown trout less than five years of age were present in the samples studied.

Fifteen brown trout were reported caught in 1936 that averaged 2.18 pounds apiece and weighed up to seven pounds. Predation by a few such large brown trout is presented as one cause of low survival of planted trout and the removal of such fish by selective gill netting operations is suggested as a possible management measure in lakes where destruction of entire populations by poisons or other means is not desired.

GONAD MEASUREMENTS AND EGG COUNTS OF BROWN TROUT (SALMO TRUTTA) FROM THE MADISON RIVER, MONTANA*

*Contribution from the Michigan Institute for Fisheries Research and the Zoology Department, Montana State College.

By C. J. D. Brown and Gertrude C. Kamp
Michigan Department of Conservation,
Ann Arbor, Michigan

GONAD STUDIES WERE MADE ON 41 female and 15 male wild brown trout, Salmo trutta, from the Madison River, Montana. The left ovary, with some exceptions, was found to be longer and heavier and to produce more eggs than the right. The average number of eggs produced by the right and left ovaries was 589 and 679, respectively, and the average of all eggs per female was 1,285. There seemed to be little or no correlation between the length, weight, condition, or age of these females, and the number of eggs produced. The gonads made up 1.7 percent of the body weights of the males. The weight of the testes did not show up any correlation with the length, weight, age, or condition of the fish studied.

OBSERVATIONS ON THE LIFE HISTORY OF THE NORTHERN PIKE (ESOX LUCIUS) AT HOUGHTON LAKE, MICHIGAN*

*Contribution from the Michigan Institute for Fisheries Research

By W. F. Carbine
Michigan Department of Conservation,
Ann Arbor, Michigan

MALE PIKE MADE UP 65 percent of the 378 adults taken in the upstream weir of the ditches tributary to the North Bay of Houghton Lake in 1939. They averaged 21.2 inches, total length, while the females averaged 23.5 inches. In 1940,

58 percent of the 118 adults were males. These averaged 19.8 inches in total length as compared to 23.2 inches for the females. Most of the spawners appeared in the weir between 6:00 p.m. and 9:00 a.m. The majority of adult pike tagged in the upstream weir returned to the lake after remaining in the ditches for varying periods of time.

In 1939, 7,239 young northern pike passed through the downstream weir from the spawning grounds to Houghton Lake. The young grew at an average rate of 2.03 millimeters per day for the first 75 days. In 1940, 1,495 young pike returned to the lake. The young grew at an average rate of 1.46 millimeters per day for the first 85 days.

RELATIONSHIP BETWEEN FRY PLANTINGS AND PRODUCTION OF WHITEFISH IN LAKE ERIE

By John Van Oosten
U. S. Department of the Interior, Fish and Wildlife Service,
Ann Arbor, Michigan

AN ATTEMPT WAS MADE to substantiate the repeated assertions of the commercial fishermen on the Great Lakes and of others that there was a direct causal relationship between the plantings of whitefish fry and subsequent catch. The records of whitefish fry plantings in Lake Erie during the years, 1920-1938, were correlated with those of catch during the period, 1923-1940. No causal relationship could be demonstrated between the two sets of data. Whitefish production in Lake Erie is not dependent on or noticeably affected by the planting of fry.

POND PROPAGATION OF THE SILVERY MINNOW, HYBOGNATHUS REGIUS GIRARD

By Edward C. Raney
Department of Zoology, Cornell University, Ithaca, New York

THE SILVERY MINNOW HAS BEEN successfully propagated in a shallow earth pond, 0.15 acres in area at the Cornell Experimental Hatchery. It spawns in late April and early May over a silt bottom and requires no aquatic vegetation. The males may be recognized by their yellow color and the presence of minute tubercles on the body. The pond was fertilized three times during the summer with cotton seed meal, and some freshly cut timothy was scattered along the shallow borders at intervals. No food was given. Breeders (68 females and 16 males) from Cayuga Lake were introduced in the spring of 1938. In late September, 6650 young which averaged 61 mm (range 41 to 72 mm) in total length were recovered, giving a production of approximately 44,000 per acre. Several thousand were retained in the same pond through a second summer and attained a length of 80 mm (65 to 89 mm). These fish matured and spawned during the next spring (1940) and by September the males had reached 82 mm

(76 to 87 mm) and the females were 88 mm (78 to 96 mm). The Silvery Minnow is an important baitfish in central New York being used early in May for pickerel and pike and later in the season for yellow perch and bass. It may be used as a forage minnow in the propagation of bass and gives promise of filling an important niche in muskalonge culture where an early breeding minnow is needed for feeding the newly hatched young.

AUTUMN FOOD OF RECENTLY PLANTED YOUNG BROWN TROUT IN SMALL STREAMS OF CENTRAL NEW YORK

By Edward C. Raney and Ernest A. Lachner
Department of Zoology, Cornell University, Ithaca, New York

POPULATIONS OF YOUNG BROWN TROUT (from 66 to 111 mm in total length) were sampled during late August to November at known intervals after they had been planted in two streams. The stomach contents of 75 were analyzed. Two days after planting 16 out of 26 stomachs contained some food; 82 percent by volume was of aquatic origin. Only insects were eaten and of these Ephemeroptera and Diptera were most important. After 16 days, each of 20 stomachs contained food. Aquatic food still predominated (86 percent) and a large part (93 percent) was insect. Ephemeroptera and Diptera were still more important although beetles (Coleoptera) were present as 21 percent by volume. Earthworms, Arachnida and Isopods were also eaten. After 42 days 10 trout were obtained. Aquatic organisms still made up a large part (79 percent) of the stomach contents. Insects still predominated (86 percent), and, while mayflies (Ephemeroptera) were still most important, Diptera, Orthoptera, Hemiptera and Plecoptera were well represented. The remains of a fish was found in one stomach.

In another stream with a different bottom fauna 20 out of 22 stomachs contained food 3 days after planting. Most food (95 percent) was aquatic in origin and 95 percent was insect. Diptera and Trichoptera were most important.

COMMENTS FROM OUR READERS

"Hands Off" Good Motto in Releasing Fish

EDITOR, the PROGRESSIVE FISH-CULTURIST:

Amongst the many interesting articles in the August PROGRESSIVE FISH-CULTURIST I was particularly interested in reading the article "Are Undersized Trout Killed by Hooks?"

My own experience, both in fishing public waters and fishing on my own place where I could watch the trout pretty carefully and detect any losses, concurs very closely with Mr. Westerman's report. It would be interesting in this connection to get the figures of the Pennsylvania Board of Fish Commissioners on the Spring Creek controlled fishing area. As I recall, one year the record showed that about 8,400 trout had been caught and returned to the water, while our men patrolling the property night and day were able to discover only 43 dead fish from encounters with hook and line. Incidentally many of these fish had been caught and released many times.

Of course there the larger size, averaging as I recall at least a foot in length, would reduce the mortality somewhat as would the restriction to only artificial fly and barbless hook. On the other hand, many of the fishermen had never caught a trout and the handling of fish returned was anything but careful and considerate.

In this connection I feel that the admonition to wet one's hands before releasing the fish should be discarded in favor of more practical advice. In about nine cases out of ten the careful dry-fly fisherman can release his fish without ever touching it, even when using a fly with a barbed hook, by grasping the bend of the hook between the thumb and forefingers and turning the bend up. With a quick, deft movement of the fingers usually the weight of the fish will be sufficient to disengage it from the hook.

When this won't work I draw the trout up just above the surface on the leader (if he is not too heavy) and with his mouth hanging open as it usually is, grab the lower point of the jaw between the thumb and forefingers while extracting the hook with fingers of the other hand.

I believe wet hands or dry hands are beside the point. Wet or dry, any self-respecting trout resents being taken in the hands and scraps to release himself. With a wet hand the difficulty of holding the fish is increased that much by the better film of lubrication, and in order to hold him he is apt to be squeezed that much harder. I think most of the damage is done by squeezing the internal organs, so instead of advocating wet hands let's advocate hands off, except for holding the point of the lower jaw between the thumb and forefinger when necessary. (Not recommended for muskellunge or northern pike.)

Kenneth A. Reid
Executive Secretary
Izaak Walton League of America

A Floating Tub

EDITOR, the PROGRESSIVE FISH-CULTURIST:

The accompanying picture shows a "floating tub" in conjunction with seining operations. We first conceived and put this innovation into use last summer, and found it so practical that we should now find it difficult to do our seining without one or two of them on the job. Here's the formula:

An automobile-tube slipped around an ordinary galvanized wash-tub, well toward the top, then inflated.

A size 600 x 16 tube over a No. 2 tub fits nicely.

Geo C. Hollopeter
Fish and Wildlife Service
Louisville, Kentucky

Collecting Fish Eggs

EDITOR, the PROGRESSIVE FISH-CULTURIST:

There has been in the past a general idea that the process of removing the ova from fish is rather a simple matter once the method has been described to the uninitiated. This, unfortunately, is a fallacy.

The removal of the ova may be simple, but to know when to remove is another matter and an art that is very difficult to impart to the beginner. It is well known among many fish-hatchery workers, who have the unpleasant duty of separating the infertile eggs from the fertile, that some spawntakers, who have spent many years at this work, have never been capable of detecting the critical time when the ova are in perfect condition to be removed.

Eggs may be "squeezed" from a fish several days before the delicate organism is advanced sufficiently that the sperm is able to complete the union. Although these eggs, following the introduction of milt, may appear to be quite healthy, the vital sperm has failed to enter the micropile and the eggs therefore remain infertile.

A most conclusive paper has been written on "The Mechanics of Fertilization" by A. B. Peart. Many tests were made to determine how long the ova, once extruded, would remain capable of receiving the sperm. The results proved that when the egg has come in contact with water its ability to receive the sperm is reduced after a period of three minutes, and that after immersion in water for five minutes the fertilization only amounted to 65 percent. Likewise, the milt, providing that its mass is dispersed, will become ineffective within thirty seconds after contact with the water. Studying such a paper as Peart's throws quite a light on the failure of some collections of eggs, when the operator has not a fuller knowledge of the mechanics of fertilization.

Further information on stripping technique was published a short time ago by Dr. Clifford Carl, who conducted a series of experiments to determine to what extent the presence of ruptured eggs will prevent the entrance of the sperm into the

micropile of the unruptured egg. While the author of the publication lays no claim to definite conclusions, the deductions put forward do corroborate the suspicions of many fish-culturists.

If the need for distribution of fish eggs continues to increase from year to year, it would seem that a continual supply of efficient strippers will be in demand. To meet this, every effort should be made by the present operators to understand the actual mechanics of the process, which can be accomplished only by having access to literature on the subject written by those who have made scientific studies and tests.

I would like to recommend the following papers in particular, all of which are well worthy of careful study:

"What causes blank fish eggs" by Donald R. Crawford from THE PACIFIC FISHERMAN Seattle, May 1923.

"The mechanics of fertilization in trout" by A. B. Peart Salmon and Trout Magazine, London (Date unknown)

"Artificial spawning methods for Sockeye Salmon" by R.E. Forester, Bulletin L. Biological Board of Canada.

"Beware of the broken egg" by G. Clifford Carl. PROGRESSIVE FISH-CULTURIST, No. 53.

The following pointers should be borne in mind during spawning operations.

1. Treat the fish very gently at all times. Do not return the fish to the water by throwing or dropping from any height. Serious damage may be caused by the rupture of eggs, which not only affects the quality of the eggs but may be the means of injuring internal organs or cause premature death.
2. Do not attempt to remove all the eggs in any one day. Even at the height of the spawning season it has been found that very few fish have all their eggs ready for fertilization at one time. It is better to get those eggs that are in prime condition to receive the sperm-cell, than to take every egg and have to remove them one by one from the baskets in the hatchery at a later date. Green eggs will not take the sperm cells.
3. In the process of stripping, remember that when a fish is quite "ripe" very little pressure is necessary. If eggs when leaving the vent appear "ropey" and cling to the anal fin, it is a sign that the fish is not yet ready for stripping.
4. It is a good practice to keep some undispersed milt among the eggs in the vessel used for the reception of the eggs, so that when a fresh batch of eggs is extruded into the vessel, a supply of fresh milt is on hand ready for dispersal, to avoid the danger of the eggs becoming water-hardened before the sperm-cells can enter the micropile.
5. Thoroughly understand the mechanics of fertilization, and keep these principles in mind throughout the stripping operation.
6. Endeavor to obtain a collection of all good eggs, whether that collection be large or small.

F. Pells
Cultus Lake Hatchery, B. C.

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